

April 3, 1961

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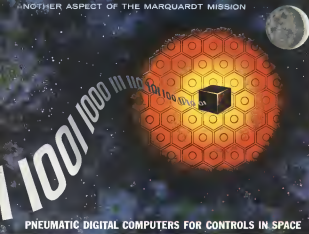
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AVIATION CALENDAR

- Apr. 18-19—Spring Meeting, Western States School/The Combustion Institute Association, Division of Fuel Motor Co., Newport Beach, Calif.
- Apr. 20-14—International Symposium on Aviation Research and Development, Federal Aviation Agency, Atlantic City.
- Apr. 21-22—Conference on the Ultimate Status of Semiconductor Materials, Air Force Cambridge Research Laboratories, Boston, Mass.
- Apr. 23-24—19th Annual Spring Technical Conference, Institute of Aeronautical Engineers, American Rocket Society, Third Ave., Cincinnati, Ohio.
- Apr. 25-26—Annual Meeting, National Aeronautics Services Ass., Hotel Washington, Washington, D. C.
- Apr. 26-27—Institute of the Aerospace Sciences, American Aviation Meeting, Idaho Falls, Washington, D. C.
- Apr. 27-28-19th Technical Conference, International Air Transport Ass., Delta Clubhouse Hotel, Montreal, Canada.
- Apr. 29-30—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.
- Apr. 29-Enter Report Meeting, Society of Navigation, Sheraton Hotel, Washington, D. C.
- Apr. 29-30—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.
- Apr. 30-21st Annual Meeting and Conference, American Ass. of Airport Executives, Sheraton Hotel, Colorado Springs.
- Apr. 24-27—1st Meeting, Aerospace Medical Ass., Palmer House, Chicago.

(Continued on page 6)

AVIATION WEEK and Space Technology

April 3, 1961
Vol. 74, No. 14

Aviation Week and Space Technology is a leading authority on all matters relating to the aircraft industry. It is the only publication that provides a complete and authoritative survey of the entire industry, from the design and development of new aircraft to the production and operation of existing aircraft. The magazine is published weekly, except for two issues which are published bi-weekly in January and February. It is a must-read for all those concerned with the aircraft industry, whether they are designers, engineers, manufacturers, or operators.

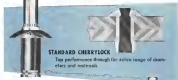
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Visicorder and record shown in actual use.

How the Visicorder helps keep "spring" in a free gyro

by simultaneously recording several performance characteristics

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Five channels of a Honeywell 906 Series Visicorder are used in the test for uncaging time and gimbal drift.

For the uncaging time study, a gyro is fired to release the gyro's spring motor. One trace indicates spin rate (A). When the gyro attains correct speed (full operating condition), a switch closes to record another trace (B). Between these traces, a 500 cps tone is a convenient time reference (C).

The gyro is mounted on a Secordy table set to deflect the unit 7 1/2 degrees from the perpendicular about two axes. Potentiometers sensing the gyro's deflection are directly connected to plates which measure the position of the gyro gimbals as the unit is rotated on the fixture. The potentiometer outputs trace individual sine waves on the record (D) which are easily compared to a zero trace (E) to indicate gimbal drift.

The records shown here in two parts are actually one continuous record. Immediately after the uncaging time test, the record drive was switched to



In this simple bench set-up, the 906 Visicorder is at right. Above it and the record panel is the Secordy table on which the gyro is mounted, ready for test.

lower speed without stopping the record. The resulting traces are easy to compare and gimbal drift is measured immediately.

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This record at left was made at a speed of 20" per second. The record above is a continuation, after record speed was changed to 1" per second without interrupting the test sequence.

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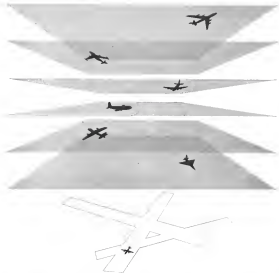
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The First Decisions

President Kennedy's defense budget message (see p. 26) provides a clear blueprint of the first round of decisions taken by the new Administration in the Pentagon and some sharp pointers of its future policy in reshaping the military establishment. The most important aspect of this message is not the usual \$2-billion increase in major weapons system development proposed or the relatively minor cuts recommended. It lies in the simple fact that the message contains basic decisions made on the basis of necessarily swift but nevertheless thorough analysis of what had become an increasingly complex and disorienting situation where major decisions were made by drift and indecision rather than positive, calculated action.

The approach of decision and positive direction to the military program should be welcomed not only by the defense industry but by every American citizen who puts trust and expects an adequate defense of his nation and principles. Any group of executives, whether they be in government or private business, who make decisions and chart a forward course will inevitably generate a normal percentage of bad decisions and blunders. Thus will also inevitably meet the work of those whose pet projects are rejected and whose concerns they are passed.

More significant of the budget message is the action to put 220 more ICBM's in operational launch sites by the end of 1966 than had been previously programmed. This indicates, better than any quibbling over semantics, that a major gap of major significance was developing and that firm positive action can still be taken to reduce its peril. When an increase of this magnitude in our deterrent power is possible through mere vigorous program stimulation, it becomes crystal clear that despite earlier pretensions that all possible energy was being allocated to this problem, this was not the case, and the opportunity for more effective action only awaited executive direction of sufficient scope backed by hard resources.

The increase in the Minuteman and Polaris programs, plus continuation of the so launched Skybolt, will concentrate the entire U. S. deterrent force on the successful operation of ballistic missiles in the critical period from 1963 onward. Never in the entire history of the nation has its future ever depended so heavily on a single basic type of weapon. Despite the disposal of an increasing pool of hardened land mine, ordnance and so on, the ballistic missile will become the sole source of Soviet concern for the next decade. This will place an unprecedented premium on the development of an effective ballistic missile defense system. For success in this defense area would make it possible to achieve a military equilibrium in a single technical move.

Admittedly, the ballistic missile defense problem seems so formidable. The doubts of U. S. scientists on an early solution in this country are reflected in the decision to postpone production of the Nike Zeus system and

the somewhat then funding of longer range anti-ICBM studies. Based on our own progress, or lack of it in this field, the current U. S. defense policy is gambling on a similar deficiency in the Soviet defense system for at least another decade. This gamble can be based on what both now to be excellent odds, but it is nevertheless a gamble. As such, it could fail with disastrous results.

It appears that considerable past effort should be spent developing some additional new types of defense systems for multi-mission work during this period of fire no other reason than the fact that the Soviets will be permitted to concentrate their technical resources on the defense possibilities of a single defense system if we lack any other defense methods. We are not inclined to get too excited about the scaling down of the B-70 bomber program, as proposed in the Kennedy defense budget. First, contemplated by prior reduction, a beginning to catch up with the once promising advanced step forward. The stopping of its first possible operational date to the late 1960s delays much of its original attractive new as an alternate defense system to ICIM's.

We are inclined to shed a larger tear for the wiping out of the secret nuclear propulsion program as a far too early abandonment of what is still a revolutionary, and promising line of development for a whole family of aerospace vehicles.

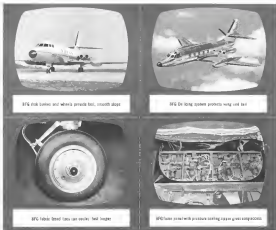
The budget makes no mention of the increasing fatigue problem being encountered by Strategic Air Command with its heavily loaded B-52 fleet due to conditions encountered during refueling operations and high gross weight takeoffs although these problems raise serious questions as to how long that fleet will remain effective even if armed with Skybolts. Although vague mention is made of studies proposed for a new type of bomber aimed at functioning in the environment of a U. S. USSR ICIM capability and Dyna-Soar in getting a significant funding boost, no aspect that the increased vehicle gap may become critical during the decade ahead unless some vigorous thought and action is applied.

Certainly the budget increases used at more effective than capabilities are long overdue. Although these increases are relatively small compared with the ICIM boom, they show firm determination to proceed in these long neglected areas and activate a number of significant projects for the future, such as the \$45 million for the massive SIOG, fighter and \$172 million for increased R & D programs.

The action to begin the theory but long overdue task of closing down military bases and installations no longer necessary to support the changing technical pattern of defense should be welcomed by taxpayers regardless of the impact on specific local economies.

The decisions in the new defense budget message are but the first in a pattern that will unfold during the next year. They are certain to stir bitter debate in Congress, and we can expect Kennedy Administration officials to be constantly criticized in their defense.

—Robert Holt



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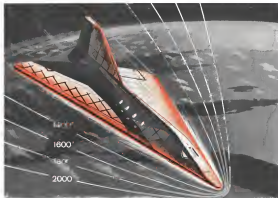
Ability of the JetStar to operate from small fields, of less than 5000 feet, demands dependability on the runway. Here BFG disk brakes and wheels, of

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Atmospheric Skin Diver... 1980 Style

Double-walled honeycomb panels of Haynes alloy No. 25 may form the "skin" of a rocket-propelled space glider, provides a major research company. Already successfully tested, these panels are designed to withstand the terrific temperatures generated as the glider dives back into the earth's atmosphere.

The subsonic glider's 30 passengers and crew from this blazing re-entry heat, its whole skin, except for leading edges and tail surfaces, will be made of the Haynes alloy No. 25 panels. Beneath these, a layer of thermal insulation. And liquid circulating through these walls and surfaces will be cooled by water to be expanded or steam. Haynes estimates that a "skin" of this basic type is highly practical. And it seems certain that many other tough, heat- and corrosion-resistant Haynes alloys—many already proved at 2,000 deg. F. and above—will also be needed.

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Engineers discuss double wall test method on space glider skin with a honeycomb alloy model made of Haynes alloy No. 25 designed for subsonic laminar flow of re-entry.

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Washington Roundup

Balanced Space Effort Endorsed by Kennedy

President Kennedy finally has addressed himself directly to the tug-of-war between the military services—chiefly the Air Force—and the National Aeronautics and Space Administration over space missions and dollars. There is consolation for both sides in what he has to say.

On May 9, Chairman Orrin Rosten of the House space committee wrote to the President expressing concern over the "quasi-public failure" in which military use of space is being promoted and over the implication that the executive branch was contemplating "a radical change in our national space policy" that would allocate military space "at the expense of civilian and peaceful uses." Last week, the White House, apologetic to let Rosten release the President's reply, dated May 21.

"It is not new to me that it may seem an intention to subordinate the activities of [NASA] to those of the Department of Defense," he said. "Contrary to the view of his predecessors, President Kennedy said he believes 'that there are legitimate reasons in space for which the military services should assume responsibility.' But he said there are 'strong reasons' such as the scientific, commercial and peaceful exploration of space and the application of space technology to the conduct of peaceful activities, which should be carried forward by the civilian space agency."

The President and the national space council will no longer be "just a box on an organizational chart" and will be well off on Vice President Lyndon Johnson's, the council the congressional consultation, and private industry for a strong civil program.

U.S.-Soviet Bilateral

U.S. military officials were given a closed-door briefing last week by Cyril Anisimovskii based on its step-by-step program for negotiating with Soviet Russia for a reciprocal exchange of operating rights on the New York-Moscow route.

The meeting followed State Department's second bid for the route since President Kennedy took office. Russia did not respond in the first note handed to the Soviet embassy here Feb. 24, although it was generally known that the military was under instructions from the Kremlin to send out congratulatory opinions on the proposed route.

U.S. still is not eager for a negotiating session, but for the first time since the New York-Moscow question was launched in 1958, the government has at least indicated its approach. Proposals will be based on a simple New York-Moscow route, with right of passage for schedule frequency and buffer capacity. For American, which was given the route by Cold right after World War II, would require reduced details for the Soviet side. Besides, over the government needed permit agreement.

The agreement will not follow the pattern of the Bermuda agreement, since Russia is not a member of either the International Air Transport Association or the International Civil Aviation Organization.

Latest Pentagon management discussion to be held under extremely tight internal security is a consideration of direction of possible travel and equipment. Announcement of the decision can take late last week. Defense Secretary Robert McNamara, presided by the House Government Information Subcommittee on its long, inquiry into protection of arms information, and he will try to ensure "the fairest possible flow" of reliable information.

But he said "true security information must be protected to the maximum extent possible." It is applying the same yardstick, in congressional discussion, would be a wish to talk about this.

Manned Bomber Flop

Biggest fight over President Kennedy's proposal to cut the B-70 Mach 3 bomber has been a development project now come inside the Air Force rather than in Capitol Hill. Congress—partly because contracting for a full weapons system would have been spread through so many states—now press for more than the White House wants.

But within the Air Force, many leaders, advocates already were warning Secretary Eugene Roser's office last week to protect. Zuckert is expected to support the McFarlane-Kennedy decision. The President did not ask for any increase in B-52 or B-58 strength further sheltering the bases of those who use a need for manned bombers.

A small glimmer of hope remained as the President's words that a B-52 "or successor bomber" equipped with Skybolt might be as useful as a B-70, and in his statement that "We should also explore the possibility of developing a manned bomber which specifically designed to operate in an environment in which both sides have large ICBM forces."

The similarity between the President's lack of enthusiasm for the B-70, nuclear aircraft program, and the President's decision to cut the liquid-fueled Atlas and Titan and the crew of President Eisenhower did not go unnoticed.

—Washington Staff

Kennedy Stresses Solid Rockets, Limited

Defense budget request increased \$1,954 billion; Polaris emphasized, B-70 cut back, ANP canceled.

By Larry Bonds

Washington—President John F. Kennedy had not placed enough emphasis on solid propellant ballistic missile defense of nuclear weapons and accelerated preparation for launching conventional limited war in asking Congress for \$1,954 billion in additional new obligations authorized over the fiscal year 1962 Eisenhower budget request.

The President further emphasized the shift from aerial to missile by curtailing the B-70 Mach 3 bomber program from a complete weapons system to a flying prototype. He also succeeded in reducing a number of other programs, including development of nuclear aircraft engines.

Major support of the new missile will be the Navy's Polaris Ballistic missile weapon system, which is scheduled to receive an additional \$1,140.5 million. Air Force's Atlas-Satellite Minuteman intercontinental ballistic missile will receive \$96 million more and Skybolt air-launched ballistic air-to-air program will receive \$50 million. A total of \$58.9 million is authorized for limited war weapons, per centage of weapons and transport and personnel increases aimed at increasing limited war capability.

President Kennedy, coupled his limited economic program with a state fiscal year which will be the first year he will need to strike the first blow. We must either launch an advance that may appear to have an aggressor in its rear, or the capital will be forced to respond in this and effectively to an aggressive nation, in its common aim, will be aggressive that such a name

ment would be too high and costly to undertake.

Defense Concept

In referring to decisions of delicate nuclear attack, he said, "The decision must not depend upon a simple comparison of numbers on hand, but on the fact that he has been publicly admitted to be a world leader that this nation has not lost the world in world strength. But what we have and want continue to have in the ability to survive a first blow and respond with devastating power. This devastating power depends not only on the number of warheads and bombs, but on their state of readiness, their ability to move, attack and the flexibility and reaction with which we can control them."

Mr. Kennedy recognized that arms would be subject to intimate civilian

control and control. In that end he committed more funds to building a communications system which, in as short a time as possible, would enable the President to know that an attack is on its way and then order appropriate action.

On the subject of long-term effort was, Mr. Kennedy said, "The strategic and alignment of our forces to respond to those of our allies should be sufficiently powerful and mobile to prevent the steady erosion of the Free World through limited wars and it is this rule that should govern the present situation of our defense forces."

One objective, now, is to increase our ability to conduct our response to non-nuclear weapons and to have the means for our limited aggression by making clear what our response will be.

Issues requested by Congress actually amount to \$2,704 billion. This amount would be reduced by \$700 million resulting from recommended cancellations and reductions of other transfers from capital funds of military activities which amount to a profit. Of the war funds added, \$610 million would be spent in fiscal 1962.

Project Cancellations

Savings would come from the following actions:

- **USAF-Martin Titan II**, shorable liquid-fueled ICBM first stage, was to be reduced from 14 to 12 squadrons at a saving of \$100 million. Re-arming request for 41 Titans for fiscal 1962 would be \$1,014.5 million.
- **Phaseout of USAF-B-47**, 1047 nuclear bomber units, reduced but retained in inventory as a result after the collapse of the current management was, accelerated at a saving of \$14.7 million.
- **USAF-Northrop X-47**, advanced nuclear missile, was based on the Polaris, but, would be placed out saving \$6.9 million.

- **USAF-North Atlantic B-70**, which had previously been cut back to an interim prototype status during the Eisenhower Administration and then was increased last year to a 12 plane support program after intense political pressure, had been canceled, now would be cut again to four planes, limited to engine engine and launch launch program. Saving would be \$136 million, leaving \$216 million in the fiscal 1962 budget request in need of \$154 million.
- **Nuclear-powered aircraft** would be taken from Air Force program, and given completely to the Atomic Energy Commission. USAF had asked \$15

War Forces

million for fiscal 1962. This request would be eliminated. AEC requested \$15 million for research funds, plus \$2 million for spending equipment. There is doubt if this sum will enable work on both General Electric's direct engine approach and the Pratt & Whitney indirect cycle. The program has been the subject of constant cut and changes in status over a period of 30 years.

- **Navy's Eagle-Mike** on defense missile would be canceled completely. The Douglas Phantom anti-missile missile was not funded in the Eisenhower budget would have carried the long range Eagle-Eagle anti-aircraft missile. The saving by canceling Eagle would be \$57.7 million. Eagle also was scheduled for use in a Boeing Boeing defense concept called Project Arrow. This would have used modified Boeing B-45 bombers in firing radar systems carrying search and attack radar and acting in airborne command centers that would fly up to 24 Eagles each. The aircraft would have been ground based, would have had a 5 min. time frame, and would have been able to operate with the high air defense command system or independently, using ground airframes for as long as 11 hr. The President and 'no alternative' for Eagle is in progress.
- **Evolution of the Navy-Lockheed Polaris** on the nuclear-powered cruise long range, would be canceled at a saving of \$57.7 million. Mr. Kennedy said the money would be better spent on the far less vulnerable Polaris sub missiles.

An additional saving is claimed in transfer of funds from such activities as the Military Air Transport Service and the Military Sea Transport Service which changes status for the service and then a profit.

The President's action indicates that he believes there is a missile gap in reference to the Communist bloc capabilities, but not necessarily as overall deterrent gap. The move in ballistic missile arms is toward having at least 702 of them available in 1964. Of this total, three would be 160 Polaris, two thirds of which could be on status at any given time. This is not considered too many, since the gap at that time, but sufficient strength in located defense capabilities would be available.

It is estimated that there will be 1,500 missiles available by 1965 and 1,710 missiles by 1966. This number is expected to be increased to 2,000 missiles by 1967. This would consist of 474 Polaris under a 24-submarine program, 1,000 Minuteman and the remainder Titan I's. But this time it is

Proposed Changes—FY 1962 Defense Budget

New Obligational Authority

Program	Millions of Dollars	Proposed Adjustment
Strategic Systems		
Polaris	\$1,140.5	
Minuteman	96	
Skybolt	50	
Increased ground short range and long range	44.8	
Missiles	20.8	
Reduced cost of air defense interception	80.0	
Increased command and control of defense deterrent	16.4	
Research, including production only Development, Advanced Defense, Research and other	226.0	
Limited War		
Expanded research on air-to-air weapons	123.0	
Additional research on ground weapons	77.7	
Additional amphibious transport of new type	18.0	
Navy ship modifications and modernization	34.4	
Procurement of new weapons transportation	216.0	
4000	40.0	
Modification of F-105 nuclear fighter	210.0	
Increases in personnel strength	30.0	
Increases in actual pay	19.9	
Increased research training Army and Air Force	68.5	
Communications and Radiofacilities		
Expansion of the Air Force's air operations	100.0	
Accelerated plan of B-47 bomber wings	14.9	
Placement of launch operational missile	5.7	
Reduction in B-70 program	118.0	
Change in status of missile nuclear propulsion work	15.0	
Cancellation of Eagle missile	57.7	
Cancellation of Polaris missiles on Long Range	32.0	
Transfer from working capital funds (MATS, MSTS, etc.)	117.0	
Total increase in request NDG	\$1,954.0	

planned that Atlas and Titan II would be used in force only because of high cost in keeping them ready for firing.

The Polaris program, already one of the most successful in the history of the President's first office when he or could more rapid construction of five submarines. The total number of ships authorized at that time, was 29. Now the plan has been accelerated from 19 1961 it is planned to construct them at the rate of one per month. All 29 are expected to be operational in 1965, two years earlier than under the present long range plan for per year.

Development of the Polaris missile also will be accelerated. The present operational Polaris has a range of 1,200 mi. In order to see placement on the 1,500-mile A2 status and get the 2,300 mi. A3 a new contract for the latest recommended concentrated effort on the A3.

This longer range missile with its proved penetration capabilities will provide evidence the potential threat of the Polaris fleet and reduce its exposure to shore-based air attack and nuclear warhead attacks," the President said.

Of the \$1.36 billion in new funds

for Polaris, \$270 million will be spent in 1962. Additional new requirements will necessitate the addition of 3,000 more at a cost of \$15 million. Additional funds are also needed for other more crew training and practice firing.

The mobile version of the Minuteman ICBM, which is intended to be placed on short railroads, will be kept in a research and development status. Three of the planned mobile squadrons will be canceled and three squadrons added to the first series, which will be fired from vans. Each field squadron has 10 missiles.

Minuteman production capacity will be doubled. There will be no second wave in such because there is already a wide representation among contractors in the program who can increase in domestic their efforts. Some of the \$55 million will go into design changes to improve reliability, guidance accuracy range, and re-entry ability in these changes can be accelerated earlier than previously planned.

The Eisenhower request for Minuteman was \$117.5 million. The new figure will be \$1,013.5 million. More money will be made available for practice firing which is in the case of the

Revised Defense Budget Summary

(Millions of dollars)

	New Obligational Authority		Net Decreases	
	FY 1960 Actual	FY 1961 Estimate	FY 1960 Actual	FY 1961 Estimate
1. Decreased budget FY 1961 budget request	22,075.0	27,080.0	5,005.0	5,005.0
2. Effect of action items (a) to (c) and (d) and (e) and (f) and (g) and (h) and (i) and (j) and (k) and (l) and (m) and (n) and (o) and (p) and (q) and (r) and (s) and (t) and (u) and (v) and (w) and (x) and (y) and (z)			7,504.0	10,010.0
3. FY 1961 obligations approved by the Senate		420.0	10.0	420.0
4. Adjusted budget FY 1961	22,053.0	26,660.0	4,607.0	4,590.0
5. Effect of action items (a) to (c) and (d) and (e) and (f) and (g) and (h) and (i) and (j) and (k) and (l) and (m) and (n) and (o) and (p) and (q) and (r) and (s) and (t) and (u) and (v) and (w) and (x) and (y) and (z)			34.1	2.0
6. Adjusted budget with executive order	22,018.9	26,617.9	4,601.0	4,588.0
7. Effect of President Kennedy's budget request		1,000.0	10.0	100.0
8. Budget approved by President Kennedy	22,018.9	27,617.9	4,611.0	4,688.0

Excludes of Budget Pay (200) and of Executive Order (200)

1. Excludes of net of expenditures of funds

2. Excludes of requested production and construction orders in order to strengthen the military forces and civilian the economy

on 100 wt.

AIR TRANSPORT

DME Use Urged to Break Traffic Control Bottlenecks

Operational advantages detailed by David Thomas at FAA-industry meeting on mandatory requirement.

By David H. Hoffman

Washington—Widespread civil use of distance measuring equipment will help rid the air traffic control system of bottlenecks and relieve present pressures on pilots and controllers, according to David D. Thomas, director of the Federal Aviation Agency's Bureau of Air Traffic Management.

Defining operational advantages of DME, today a necessity of aircraft operations and avionics manufacturers here, Thomas maintained that prompt exploitation of the 580 U. S. navigation aids equipped to offer distance information would speed the flow of traffic while FAA is expanding its radar service and refining tower information.

FAA called the conference to assess aircraft operator exposure to the system first DME, would be made mandatory on all active runways. Most parties attending, including the Air Transport Association, agreed the proposal was sound.

But in the meeting addressed the time when DME should become compulsory, was still at issue. Among FAA's tentative Jan. 1, 1962 deadline "actual use," unless generally licensed a target date at least a year later.

According to Thomas, who presented the pilot controller viewpoint, DME would prove invaluable as a traffic control tool.

- Providing a safe reduction in the volume of airports needed to establish minimum safe height clearance between aircraft flying inside the range of radar.
- Providing pilots with a precise status for "instantaneously" determining the

Superiority of a holding pattern.

- Enabling the problem involved in communicating areas crowded with conflicting traffic and facilitating its most drastic changes.
- Offsetting continuous position fixes to pilots following a given course, along with additional and accurate approach information.
- Helping to eliminate holding points caused by the intricacies of visual monitoring radar.

To illustrate how DME might reduce tower workload, Thomas pointed out that a pilot often must know where and cross check stations to pinpoint his position for traffic controllers. Thus his attention is diverted from the more task of separating the aircraft. At the same time, information received by the controller is of limited value because it is limited to radio bearings and not path elements, in time or distance terms.

Reception of VOR stations being used for course guidance has been criticized by the group. Thomas told Norwalkers, controllers must ask for such position reports in order to establish safe separation between aircraft.

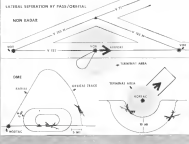
Bottlenecks

and they must receive the information quickly.

Wiles is so busy, as VOR/VAC or FACAN station use, as continuous display before the pilot flying a DME-equipped aircraft. "Thunder," Thomas said, the pilot's right to a position request can be almost instantaneous. "It may not require an equipment bearing or approach distance from either data or additional to facilitate average time problems. DME stands firm in coupling with the demands of safety as we all know them."

Thomas began a specific comparison of separation maneuvers for aircraft with DME and aircraft without DME by describing two transports descending from an airport to follow the same route at the same altitude. Looking DME, one pair of transports could take off 5 miles apart, on the descent, of order of the first aircraft had an average of at least 12 ft. better than the second. Assuming speeds of 200 and 240 ft., respectively, 20 ft. would be needed to establish separation.

Comparing separation between the same aircraft if DME-equipped could



AIRCRAFT forced to begin high density traffic was in holding pattern would save time with DME by flying related routes at a given distance from the station.

in 10 sec. As a result, more separation, the flow of traffic, a comparison which by merged weather could be patch aircraft at more than present rate, through broad use of DME.

Discussing the air route, between those 24,000 ft. along the coast, Thomas said

that even greater reduction in the space required for traffic separation was possible. Within the high altitude areas, structure, basic separation for one aircraft from the same mode and altitude, 10 miles at 450 ft. the equal 50 ft.

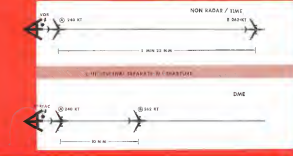
"Use of measured DME separation between the same two aircraft," Thomas said, could result in a new system of 30 ft. separation or only 25% of the distance that might result from application of the true separation standard.

When one of two aircraft from the same route wishes to change altitude or traffic control, new, more accurate that the pair is at least 5 miles apart. With DME, however, a 10-mile separation can be used to study the ascending aircraft to or through the descent of the ascending aircraft or descent of the descending aircraft to or through the climb of the one behind it.

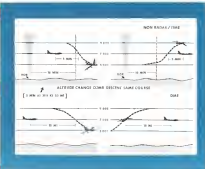
Thomas qualified this rule, pointing out that if the two transports were flying at the same altitude, their need for a speed differential to ensure that minimum safe separation is maintained.

In addition, he said, the time two separation concerns can be applied only to climbing or descending aircraft when the second aircraft is within 10 miles of a fix over which both have reported. DME separation is, however, can be applied wherever it is needed.

As to the impact of this proposal, a pilot with DME and 10-mile separation can change altitude immediately, the pilot without it must wait 10 miles



DISTANCE needed to separate two DME-equipped aircraft and two aircraft without DME, operating on identical flight paths, is one yard. Space saving along specific direct approach and departure routes could exceed 50%.



DME-EQUIPPED aircraft can climb or descend through merged strata 10 ft. from conflicting traffic. Standard time separation would save time double this distance.



LOS ANGELES AIRWAY'S S-62 touches down on tarmac at Los Angeles International Airport on a scheduled flight from San Bernardino, Calif. Landing area is between terminal fingers of American Airlines and Trans World Airlines.

S-62 Utilized for Turbine Familiarization

By William H. Gregory

Los Angeles-Fort St. Vrain turbine helicopter is scheduled to serve a single St. Knedy S-62 based in Los Angeles. As was from the manufacturer's last production S-62 by daily utilization record on a five-day week schedule.

The operation has produced some initial break in production, but first, down time has resulted in the operating schedule itself. Frequent modifications required by service bulletins for its engine, such as service area, the biggest of its maintenance problems, but for the most part, these and other major maintenance operations have been accomplished on weekends when the aircraft normally is not in service.

One scheduled flight was revealed because of an air service problem. This

was an O-ring leak in the No. 2 bearing housing line flange of the engine. Three days were lost out of the S-62 schedule in January because of a mail period engine hot section inspection and change of the main gearbox from its 62-157,000-2 to the 3.

In service problems caused two delays in schedules that did not result in cancellations according to Robert L. Thompson, manager of flight operations. One resulted from landing on air lock, traced to a turbine seal on the input shaft to the transmission. The seal has since been redesigned from a flat surface to a shoulder design to maintain much effectiveness in the flight control system was the other cause of delay.

There was one case of engine operation of the engine overtemp governor

malfunction but this was noted during preflight test and was rectified the same morning.

One case of power loss during a scheduled flight occurred shortly after engine removal, but the incident was not considered an engine failure in this sense.

During approach to the ramp at the Los Angeles Airport on an airlock at 110-100 ft, the engine flamed out. Since the throttle was at idle the pilot did not notice the stoppage from back of engine, but only when the engine temperature began to fall. Since the helicopter was in near autorotation, the pilot never completed the landing as autorotation.

With a C-130 technical representative on board the engine stoppage was produced in a training flight by pulling up abruptly on the collective pitch to initiate a climb then abruptly lowering the collective by dumping down the collective and pulling the throttle to full idle. The test was designed as part of a training autorotation landing and the landing was thus completed at the target.

The condition also was reproduced in training on itself, using the target technique, but before the ship had cleared the ground run for

Trimble was passed on adjustment of the fuel control during the engine stoppage and the engine had been brought up to cruise fuel flow in all flight regimes.

Though Los Angeles Airways makes it clear the S-62 does not fit in its present operational plans it feels the latest search has helped itself in familiarization with the engine that is to power the new Sikorski S-62 (a) in order and in turbine inspection drive training generally. Budget \$62 demand, for Los Angeles Airways is at risk of such steps and baggage capacity.

The ship was delivered in October and was operated for two months as



PASSENGERS disembark from the S-62 after it is hoisted to Los Angeles Airways gate area. Configuration provides seating for nine passengers.

a 1980-1, proving trouble with Los Angeles Airways and Federal Aviation Agency personnel. All 18 company pilots now are checked out on the aircraft on a syllabus that called for about 5 hr conventional flight training and another 10-15 hr actual operation on engine.

Two flights are operated daily. Two are in Disneyland and return to the morning on 11:00 a.m. (usually trip two to San Bernardino in the afternoon, a 45-min. one way run, and can more to Disneyland in the afternoon. Increased utilization is planned as frequency is added with the airline's emphasis on increased passenger carrying.

Full conversion of the General Electric CT58-100-1 two turbine engine has averaged 50 gph but the air line has been running enough fuel to meet FAA's 100 gph fuel consumption based on a 70 gph consumption.

This is normally less than half of 100 gph capacity.

The aircraft has been operating on full certified gross weight of 7,700 lb and useful load of 2,200 lb. Normal cruising altitude in the Los Angeles area for all Los Angeles Airways flights is 1,300 ft, and S-62 normal cruising speed is 95 kt.

Flight instructions for the airline's S-62s are followed by the S-62 and pilots have found the landing characteristics much the same as the S-55.

The S-62 has the most dynamic components for the most part.

Cabin configuration is three forward-facing seats at the rear, a bank of four seats joined back to back at the center of the cabin, and two more seats forward mounted lengthwise opposite the baggage compartment. Except

for training, one pilot operates the ship. Ground handling equipment, including stair cart, is the same as for S-55.

Since helicopter modifications were present for the engine during its first 500 hr, and since have tapered off since into refinements. These resulted in three engine removals during the proving run period for compliance.

Besides the hot section inspection removal, there was also action against drive shaft of intermediate section. This was for fuel manifold inspection in accordance with bulletin requirements.

Hot Section Inspection

General Electric has been handling hot section inspection and modification at its Ontario, Calif., plant. It will continue to perform overhaul after Los Angeles Airways acquires its S-62s, but the engine plant is to take over hot section inspection eventually.

The engine, the mechanical version of the engine T718-6, is derived to T718 ship for takeoff and 671 ship for cruise to match with the gearbox. It can be installed by Sikorski prior to delivery to Los Angeles Airways and at the time of transfer had total time of 57 hr. 48 min. since new. As of mid-March the engine had 516 hr. left time and had not yet reached the first 600 hr. overhaul period specified by FAA for its current operation.

Overhaul period on the gearbox is now only 300 hr. for its current operation, but Sikorski is preparing data for seeking FAA approval for increasing the interval. Before overhaul a major new fan gearbox overhaul, but Los Angeles Airways customers people do not consider this a major problem at present.

The S-62's current S-5 version of the gearbox has run 724 hr., or less than the time required for first overhaul. The S-5 gearbox has an input intermediate gear modified from the S-5 version for higher output at the same engine speed and has six instead of eight planets, given as the secondary stage, making for better gear life.

Los Angeles Airways does main and tail rotor gearbox and rotor head ground and provide routine maintenance.

So far the aircraft, with 500 hr. time, has shown a better track than that of the company's S-55. The latter has experienced a few that is more serious to correction than the S-62's abnormality.

Maintenance has included repair of a crack in an oil cooler support and applying a doubler to a skin crack near Station 174, in the center cabin area near the transmission.

One characteristic of the engine has been a deposit of carbon products from combustion on the valve seats near the exhaust, resulting in an oil leak from a detector. Maintenance personnel has been to clean the ship regularly to prevent the area from gradually spreading over the aircraft's left side. In addition the exhaust area is painted black.

Passenger reaction has been generally favorable, on the order of previous acceptance of finding out previous accidents. Passengers experience the power of the main cabin. Those who stay all a jet transport and into a helicopter for the first time are apt to be disappointed. But those who have ridden previous helicopters before are strongly impressed in the other direction.



ONE of the S-55s operated by Los Angeles Airways leaves the airline's based S-62, which is parked between flights at the gate area.



Dramatic proof of AeroShell Oil W stability: Becker test cells (left) run for 250 hours using a good straight mineral oil. Becker test cells (right) run for 250 hours using AeroShell Oil W. Note remarkable cleanliness.

BULLETIN:

Shell answers the ten questions

you might ask about AeroShell Oil W—world's first non-ash dispersant aircraft oil

Less oil consumption. Longer intervals between engine overhauls. Easier starting, faster warm-up, reduced wear on piston rings, cylinder bores, cam lobes, lifter faces, gears and bushings. All these benefits have been obtained with new AeroShell® Oil W. Here, in handy question-answer form, are the facts.

1. What types of aircraft can use AeroShell Oil W? Piston engine planes of any size. Helicopters, too.

2. Why is it called a non-ash dispersant oil? Because it contains special additives that help keep any, unwanted particles in the oil from clumping together and forming deposits. These particles remain suspended and dispersed until they burn.

3. How does this oil affect engine performance? It means that engine parts stay cleaner. That lubrication points get all the oil they need. Your engine runs more efficiently, parts last longer.

4. What about oil consumption? Because AeroShell Oil W means decreased wear and a cleaner engine, you can expect less oil consumption.

5. Can AeroShell Oil W reduce my maintenance costs? If you have been

using a straight mineral oil, AeroShell Oil W can reduce your maintenance costs substantially. Because your engine runs cleaner and cooler, Oil consumption is less. Thus, you can extend intervals between engine overhauls.

6. How does this oil now oil respond from a cold start? AeroShell Oil W has an unusually high viscosity index. This guards against excessive thinning of the oil when cold, yet provides outstanding lubrication when hot. Results: easier starting, faster warm-up.

7. Is AeroShell Oil W thoroughly proved? Thoroughly. It's had millions of engine hours of flight time.

8. Where is it available? At Shell Aircraft Division everywhere. Any dealer will supply AeroShell Oil W if you ask for it.

9. Can I add AeroShell Oil W to a

multi-put oil? Yes. It is compatible with all piston engine oils now being used.

10. Is there more than one viscosity grade? What do I ask for? AeroShell Oil W is available in four viscosity grades: 80 grade for small engines; 100 grade for small engines; 150 grade for small engines; 200 grade for large engines where straight mineral oil grade 100 or 120 is normally recommended.

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A BULLETIN FROM SHELL—where 1,000 scientists are working to provide better products for industry

Dissident Engineers Urge Rehiring Of Western Group to Avoid Strike

Washington—Dissident members of the Flight Engineers International Assn. last week urged a special two-day presidential panel to seek all possible means of averting an airline-wide strike against an order by governing Western Air Lines to rehire 124 engineers fired after the Boeing 747-200 began.

Representing groups from America, Pan American, Trans World Airlines and Western Air Lines, a delegation of the engineers met with Nathan Tarr, senior, chairman of the special panel. They said the strike would cost the airline \$1 million a day. The Western group had not decided to comply with the order to rehire the 124 engineers. The Flight Engineers Coordinating Assembly, to fix its problems before the Labor Department and the AFL-CIO in Washington. The group indicated it expected the three officials to meet them in late next month "within a week or 10 days" or more.

Supersonic Transport Budget Requested

Washington—President Kennedy asked Congress last week to authorize the Federal Aviation Agency to spend \$12 million on the initial phase of a jet aircraft transport development of a supersonic transport.

Although the President asked \$12 million in new fiscal 1962 obligated authority, JAA expects to spend only \$10 million on the supersonic transport program during the next fiscal year. President Kennedy's request is in part to help to support the supersonic transport which he authorized his fiscal 1962 budget before leaving office.

Funds will be used to cover costs of technical studies and studies by airlines and engine manufacturers leading to preliminary concept and design proposals which would define major cost and time planning of the project as well as manufacturing facilities for such as aircraft. Congress will let the project in a separate bill.

President Kennedy also asked for an additional \$15 million over the \$40 million already requested for federal aid to airports during fiscal 1962.

An amount of \$100,000 in the budget for the Civil Aeronautics Board was set aside for a special police study to private consulting firms to determine means against such as the Board. Studies will include survey on the role of governmental air carriers and the development of adequate of severe standards.

this 2,300 flight engineers could be expected to ensure the airline.

Engineers' union, later announced that the airline, who do not have the sanction of FEA executive approval, should have "full cooperation" to help the panel settle the dispute.

Western Air Lines and that it is wanted negotiations with FEA since wages and working conditions the three dissident groups, including the Washington, Atlanta, and Seattle, the talks did not include the issue of rehiring the 124 engineers.

At Kansas a TWA flight engineer and spokesman for the dissident group, said the new 23 dissident group of FEA members with the lack of support since the union in the AFL-CIO, and a sharp rebuff by top officials of the union who would go later in three complaints that state an immediate strike. The union with the International Brotherhood of Transportation.

Immediately after the AFL-CIO that the dissident union to TWA flight engineers who they are a union official was "not acceptable" to the idea of an all-out strike, since the larger union is creating an air transport division and expects to strike if federal aid to the industry is denied.

CAB Action Paves Way For Cargo Rate Talks

Washington—Civil Aeronautics Board last week took an important step in paving the way for cargo rate talks by approving the International Air Transport Assn. tariff conference on North Atlantic cargo rates to be held in Washington, D.C., in 1962.

As a result of the Board action, IATA tariff conference members have agreed to negotiate in a bid to bring to an end the current rate freeze. The current rate freeze has been in effect since 1958, when it was set at 10¢ per pound for cargo.

In a mail vote, earlier members agreed to make a final attempt to settle the rate issue, but several members stated they would join in the special meeting only if the Board's decision is made in a charter flight.

On Jan. 25, the CAB approved an IATA charter flight system in which the airlines "shall not prohibit the charter of aircraft to U.S. airlines to transport freight forwarders." By chartering whole flights, freight forwarders

have been able to sell space to shippers at a lower rate than the airlines. This is changed in the current system, thus ensuring substantial volumes of cargo from the airlines market potential.

The Board agreed to remove the current conditions which require in turn charter cargo traffic revenue to be paid to the airlines, agreed to maintain present cargo rates until Jan. 1, meet in conference, as soon as possible and agree to a satisfactory structure for a reasonable period of time after Jan. 1.

Airline Profits Fall Behind Revenue Pace

Washington—First eight months of past year profits failed to follow a strong trend in revenues last year.

Continental Airlines profit held about even in 1960, while United's Western Division profit declined 20 percent.

United Airlines reports operating income increased 10% to \$88.5 million in 1960, while operating expenses increased 10% to \$88.5 million. Operating profit dropped from \$17.5 million in 1959 to \$1.0 million in 1960 and net operating profit from \$1.0 million to \$0.5 million in 1960.

Continental Airlines reports 1960 operating income increased 11% to \$61 million. Total operating expenses increased 10% to \$61 million. Operating profit for 1960 was \$6.5 million—a 60% increase over 1959's \$4.1 million. Net profit, a record, was \$11.7 million.

Continental's 1960 operating income was \$6.5 million, while in 1959, its operating income was \$4.1 million. Net profit, a record, was \$11.7 million. Operating income for 1960 was \$6.5 million, while in 1959, its operating income was \$4.1 million. Net profit, a record, was \$11.7 million.

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Delta Studies New Jet Equipment; Prepares for West Coast Service

New York-Delta Air Lines considers its present jet fleet of six Douglas DC-8s and 12 Convair 440s delivered at an initial schedule to begin West Coast service, but is considering buying additional equipment.

Confident for Delta's early, worked order in the Southern Transcontinental Case (AW May 28, p. 34) is expected here. Delta will be ready to begin service then with DC-8 aircraft and piston-powered DC-7s as well. Todd Cole, vice president finance for the New York Society of Security Analysts.

Though Delta was granted considerable risk, no mileage, Cole said this included only two new cities for Delta, which has operated a Los Angeles inter-city service with American Airlines. Financial difficulties with the airline, including routing effects on the West Coast, should prevent an extended period of partial unprofitable operation, Cole said.

One prospect of possible acquisition is a newjet Airline America and Dallas-Los Angeles service is a consequence of the existing DC-8 interchange would generate \$11 million annually, in revenue. Delta's new route is a relatively thin one, however, Cole said and will need additional income.

DC is not to be done from the stock market Florida routes for actual service, Cole said, and Delta's last three 800, due for delivery in August and September, will permit expansion of West Coast operations.

As to new equipment, Cole said that Delta could get delivery of DC-8s 800s or Sud Caravelles in 1962 or the Boeing 727 in 1965 or later. Since its own airplanes would be brought in much to meet additional traffic demands as well as the West Coast market, Delta is debating the advantages and disadvantages of short-term lease arrangements for the 727.

• **Short-term lease**—jet aircraft is generally with turboprop engines would be most efficient on many of Delta's routes.

• **Offsetting** with savings could be the result of getting in service training costs in personnel.

Cole said Delta had not reached any decision, but felt that these latter expenses could well exceed the costs of operating larger aircraft on routes to which this was not best suited.

Refitting its DC-8s with turboprop engines is a possibility, Cole said, though he considered very.

In a little ahead at the industry

of dollar the manufacturers is talking. When we were talking to the manufacturers about orders, anyone change was classified as just a case of zip in and zip out.

Still, Delta follows the DC-8 for attention program with great interest. Financing of new jet orders would depend on funding. Delta is generating substantial amounts of cash through maintenance and not depreciation and deferred taxes—\$47 million projected for the three years 1961-63, which is considerably more than required for programs due for the remaining 500s and for loan repayment.

Cole located the Civil Aeronautics Board decision in the Southern Transcontinental Case a good move for the industry as a general, building a new schedule in route patterns.

The Board reluctantly refused to provide competing service between Alaska and the West Coast and followed the same approach in Atlanta and West Coast service. Cole said. Thus, again, the importance of the amount of traffic that would support competing traffic in piston operation will not do so in jet operation.

Cole also considered the Board's decision in the Central Passenger Rate investigation as the basis for a new rate of financial traffic for the industry, as a whole. Implicit in the decision, Cole felt, is that as long as the industry are meeting the reasonable rates of return specified in the decision, the

regulatory board should be able to move toward helping the airlines reach their goals. Cole feels that there will not be immediate expansion of services if carrying the loads as temporarily eased these loads.

Whether Delta will actually seek a fare increase in the face of the decision is another matter.

An increase in fare level will have a depressing effect on rate of growth, Cole said. "Revenue developed from higher load factors is much healthier than from increased fares. A 3% increase in load factor will outweigh the same thing as a 3% increase in fares for Delta.

"The encouraging thing for me about CAB is its intent to coordinate its rate philosophy with its rate regulation. Consequently, rate increases which in some instances only give the passenger the right to choose between fare or fare different point schemes, brought about the need for higher fares. Such considerations will help airlines to protect their investments by providing adequate service both frequent and equipment.

On the basis of Delta's earnings of \$21 million in its latest fiscal year, as 11% rate of return as generated by the Board for the industry, the current would have produced earnings of \$51 million in the same period.

In the last eight months of its current fiscal year, which ends June 30, Delta's net earnings on operations totaled \$1,600,000, or adding proceeds from equipment sales \$2,100,000. This represents a 6% return on investment as 21% on sales. Cole did not project earnings for the year, but estimated revenues would total \$740 million.

Sabena Acquires Interest in TSA

New York-Sabena, Belgian World Airlines, has acquired 30% of the stock in TSA Transatlantic, the Argentine airline, and has taken over TSA's sales and service functions here.

Under a general sales agreement signed recently between the carrier Sabena will handle TSA's sales, route and schedule services as well as will have except in South America TSA will perform the same services for Sabena in South America.

TSA, Argentina's largest passenger carrier, is managed by Juan Luis Nov. Vice-pres. is September 1959 with Lockheed Super II Constellation (AW Oct. 6, 1959, p. 35). It now operates Bristol Britannia helicopters on the route. TSA is not a member of Intercontinental Air Transport Association.

Apparently TSA failed to crack the U.S. market in the highly competitive South American traffic. Most of the

airline's business was in South American origin and southwestern type routes for American tourists. On May 1, TSA began doing Sabena flights for New York International Airport. Under the new agreement, TSA does its sales offices in the U.S. and Sabena takes over these functions. Sabena also will continue to handle servicing at Newark of TSA aircraft.

The agreement allows Sabena's link to reach South American routes operated by TSA, including extensive domestic routes as a significant result. In November TSA will begin service. TSA also has been hoping eventually to fly from Mexico City to San Francisco and Tokyo.

According to Sabena, TSA expects to be operating from the New York route within a few months. Initially there are by Sabena Boeing 707-120s as an interchange here providing the Belgian carrier can spare the planes.

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This finned surface oil cooler, used for cooling engine speed drive or fan bearings, lubrication oil circuits, is a structural member of the fan exhaust duct. This eliminates the need for air intake and speed drive.

These configurations are already in use on Boeing 700 T300 turbofan aircraft and may be shaped to any configuration.

tion at extremely close tolerances. Comparable in price to conventional heat exchangers, they are even more reliable and have a longer service life because of their low simplicity.

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vere structural and pressure loads. Similar units have been developed for aircraft gas turbines and ram jet ducts. This major breakthrough in heat exchanger design and fabrication is the result of more than 20 years of experience by the company in the design, development and production of heat transfer equipment.

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Here's a factual example of Gulfstream flexibility. It's a story of how one Grumman Gulfstream was utilized as a sales tool by a well-known chemical manufacturer on two important field trips. On both these trips the passengers were able to fly above weather or traffic, in comfort, in Gulfstream's pressurized cabin. They were able to land and take off from short fields close to their destinations, completely independent of ground handling facilities. And they were able to get to their destination faster because of Gulfstream's high door-to-door time and 350mph cruise speed.

TRIP NO. 1, 17½ HOURS. This field trip was arranged through Ohio and Indiana to bring together a group of distributors, providing each with an opportunity to observe and another's operations, and also to help using its local with national sales promotion. On this trip, during



a single day, the Gulfstream made 8 stops to visit 6 distributors, and covered 1,336 miles. Cities visited included Evansville, Indianapolis, Dayton and Columbus (only 71 air miles apart) and Cincinnati. That night the plane returned to New York. Minimum number of passengers was 5—maximum, 12.

TRIP NO. 2, 17 DAYS. This same company visited six European distributors to set up new orders for its products and to outline plans and programs for the coming year. Fourteen countries were visited. Meetings were held and plant tours were conducted in Paris, London, Zurich, Luben, Brussels, Cologne, Stockholm, Oslo, Copenhagen and many other cities. The manufacturer's comment on this trip—his second overseas in six months—was "on schedule—maintenance was."

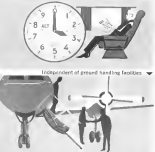
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stream ideal for 71-mile or 7100-mile trips—is one reason why over 30 Gulfstreams are now in operation. Other reasons are Gulfstream's proven safety, reliability, comfort and beauty. In short, it's a sound business investment.

Corporate executives and pilots may arrange for demonstration flights through the following distributors. In the United States: Atlantic Aviation, Wilmington, Del.; Pacific Airmobile, Burbank, Cal.; Southwest Airmobile, Dallas, Tex.; Jet-Casualty Turboprop Aviation, Montreal, Que. In Europe: Atlantic Aviation Export Corporation, London, England.

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AIRLINE OBSERVER

► Civil Aeronautics Board delays in issuing a formal decision in the United Capital merger case is due to the Board's desire to incorporate its merger policy. CAB wants this decision to serve as a precedent for future merger cases.

► Domestic airline traffic suffered severely during February. Because of the flight engineers' walkout during the month (AW Feb. 27, p. 56), traffic figures are not representative, but indications are that the industry will show approximately a 10% traffic decrease from the previous February.

► Which for Douglas Aircraft Co. is a new order for DC-8s as a result of the Southern Transportation Route Case decision and because of interest in its equipment pool in Mexico. National Airlines will need additional jet equipment urgently for its new Florida-West Coast routes, and, again, delays will make the DC-8 a strong contender. Delta Air Lines may be a larger item sale prospect (see p. 49). Delta will be a factor in the Mexican situation, but the influence of SAS + DC-8 operator, through its interest in Gulf Airway, will also be important. American Airlines, which had rejected the equipment pool idea when it received its own DC-8s by virtue of Eastern Air Lines' transferring a delivery program now and for acceptance of the plus after losing its DC-8s in a crash at New York, later national Airport. Impaired performance of the DC-8 with turboprop engines may be still another factor in the competitive sale.

► United Air Lines Executive Vice President A. M. deVeeney has been unofficially labeled the successor to President W. A. Patterson when he retires from active duty, probably in 1964.

► Reason domestic air fares, adjusted in terms of the new "hard" Soviet ruble (officially worth \$1.17) are still higher than rail rates despite the area of tariff reductions announced by Aeroflot. On the short-haul, Moscow-Moscow-Leningrad route, the jet air fare is lower than the train fare—14 rubles, against 14 rubles and 16 kopeks. Most representative tariffs are: Moscow-Kiev, 15 rubles by air, 12 rubles and 50 kopeks by rail; and Moscow-Omsk, 40 rubles by air, 35 rubles and 10 kopeks by rail. On the long-distance (5,000 mi.) Moscow-Vladivostok route, air fares are more than a third higher than rail rates.

► Group of 12 African states will organize and operate a joint domestic and international airline under a pact which links these nations' political and economic programs. Countries are Mauritania, Senegal, Ivory Coast, Volta Republic, Bahamas, Cameroon, Chad, Central Africa Republic, Gabon, Madagascar and the former French Congo.

► Projects now appear slim for full agreement between the U.S. and India on amendments to the bilateral air transport agreement between the two countries when negotiations are resumed this month in Washington. Talks broke up in deadlock last year in New Delhi over India's insistence that capacity and schedule restrictions be imposed upon U.S. flag carriers serving India. U.S. opposition to restrictions is not expected to weaken during resumed talks.

► Commission Department has formed a transportation policy group to develop a national transportation program. The eight-member group includes Robert Leifer, former secretary of the Civil Aeronautics Board, to represent aviation interests.

► Nigerian government will begin complete nationalization of Nigeria Airways Corp. this month. The government is buying the 49% of outstanding stock now held by British Overseas Airways Corp. and Overseas Shipping Lines.

► Civil Aeronautics Board plans to hold the second stage of its public hearing on the cause of New York's Dec. 16 DC-8-Super Constellation mid-air collision during the last week in April. After 77 witnesses testified in a 10-day session last January, interested parties agreed that the accident's probable cause was not apparent from the record.

SHORTLINES

► American Airlines has proposed its passenger services into one department headed by Vice President W. C. Whitson. The new passenger services department will be responsible for technical reservations, ticketing, reservations, ticket and terminal advice, stewardess college and service, food service, cabin service and field performance appraisal.

► Boeing 707 and 720 turboprops is scheduled since have flown in more than 20 billion passenger miles in over 550,000 flight hours since October 1958.

► British Overseas Airways Corp. has asked Civil Aeronautics Board to exempt its North Atlantic route between New York to Santiago, Chile, via Cuba, Panama, Ecuador and Peru. At the same time, the British airline announced it will withdraw its fleet of piston engine aircraft. The carrier will make the move as the ground that piston-craft on the fleet are too high.

► Continental Air Lines is installing a direct mail reservation system connecting major office cities with less Continental reservation offices. This system allows passengers, travel agents and connecting airlines to make reservations by calling local numbers.

► International Air Transport Assn. reports more than 1.9 million passengers and 46.8 thousand service tons of cargo were carried over the North Atlantic during 1960, an increase of 24.7% for passengers and 23.7% for cargo over 1959.

► Mexicana Airlines reports a 41% gain in passengers for August, 1960, through January, 1961, over the same period the previous year. Mexicana attributes the rise to the introduction of Comet 40s.

► Pinair do Brasil has received two Douglas DC-8 turboprop transports. The aircraft has a link past between the left inboard engine and the fuselage for transporting spare engines.

► Piedmont Airlines was scheduled to begin service Mar. 30 on a new Norfolk, Va.-Knoxville, Tenn. route. Piedmont will fly three round trips a day using P-27 and DC-8 equipment.

► Southern Airways reports over 26,300 passenger bookings and 4.8 million passenger miles flown in February, a gain of 32% and 36% respectively over February, 1960.

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THE B-70 MATC radio system management contract places in the hands of a single contractor, Motorola, an unprecedented responsibility: positive recall of a Mach 3 nuclear deterrent force. At speeds over 3,000 mph—faster than a rifle bullet—crew and aircraft safety, as well as mission success, demand integration of myriad electronic functions with simplified controls and displays. The designated MATC system includes the functions of worldwide command communications (LCC) linked to the IAC Command Network, line-of-sight, short-range communications (SRE), improved tactical air-to-air guidance (TACAN), air-to-air IFF, air-to-ground IFF, aerospace ground support equipment (AGSE), air-to-air readers and equipment, instrument landing system (ILS) and crew intercommunications. Motorola's role as a major electronic system contractor for the B-70 Valkyrie's Mission and Traffic Control typifies the systems management capabilities. Detailed information is available on request.

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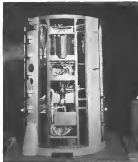
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SCOUT remains active. C, which is strapped around the north of the third-stage Astrium motor (left). Components (right) with arm-in grid mounted on the hollow-grip design tank at top, covered with insulation, are gas heater and 64th thrust pt. made to control use. Nozzle for pickup jet in transition section B (right) with reinforced outer body at left. The section surrounds the nozzle of the second-stage Castor motor. Nozzle on second-stage Castor burned off during test stage test, as it is now installed.

some, that high roll is an inherent characteristic of the X-394. Roll motor kept was then used to 14 ft.

Castor's package is a section of first, single-stage rockets, given at rocket to the vehicle frame between the third and fourth stages. Astrium and roll motor is in part of the first stage. The program works on a time and load decision to the previous gas.

First stage, control system, required

modification before the first flight because of a fear that the vehicle would flutter outside limits on the 1,000-4,000 psi environment anticipated at maximum dynamic pressure and that the flow, which has 10% of these vehicles through heating during flight, could not compensate for the flutter. Two faces were made: a bearing was added to the wheel case shaft, and the case bearing box was redesigned.

Problem of exhaust gas backing up

in third and fourth stages and making the motor before separation was solved by venting the motor nozzle on both stages. Valves are operated by the firing blast of the succeeding upper stage.

Faces that spaces would be needed on the launcher to built high-speed test, but no connection between third and fourth stages were differed when it was realized that flexibility of the



HIGH ROLL TORQUE in the third stage X-394 (left) motor, discovered in the first test launch led to detailed study of the phenomenon with the all-bearing test rig. Reinforced transition section B, which bolts to the first-stage Astrium motor, shows the flow-out separation diagnosis at right. Technician works on 600 lb thrust gas control pt.

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Scout Motor Specifications

Motor Designation	Wt. Lbs.	Power/Unit Wt. Lbs.-1	Barrel Dia.	Barrel Length In.	Barrel Thrust Lbs.	Alt. In.	Length In.
Altair (Scout Stage 1)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 2)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 3)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 4)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 5)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 6)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 7)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 8)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 9)	11,000	11,000	100	100	40	334	40
Altair (Scout Stage 10)	11,000	11,000	100	100	40	334	40

1 - 1/2 version

pointing system, changes the effect of wind drifts. Scout is not launched in winds above 10 mph, but both Altair and vehicle withstood 100 mph gusts during a November test fall at Wallops Island, Va.

Stone said that when development is complete, he expects all vehicle parts can be purchased for \$700,000. Assembly, checkout, assembly and delivery to Wallops will add \$1,000,000. Launch umb-rel assemblies, checkout, erection on the launcher and firing will total \$900,000 (\$400,000).

As for the Scout, Stone says none of the firms have competitors at NASA's Scout and both vehicles' status are becoming more similar. Because Blue Scout is classified vertically, there are some differences in design, but particularly, the components are closely enough related that launchers by other agencies have reduced the development cost of the vehicle. NASA is integrating the USAF system into its vehicle to further reduce the number of differences.

Blue Scout system is based on Atlantic Missile Range, requirement for a heavy checkout which NASA's earlier versions did not have to meet the requirement.

Constant U.S.-Europe Satellite Link Studied

Washington-Stations at 15 to 25 satellites 100 ft power satellites in 1,000-mi circular orbits could provide virtually uninterrupted communications between North America and Europe, according to a National Aeronautics and Space Administration study.

The study examines geometric and probability factors which control the lowest practical orbit and least number of satellites for an efficient transatlantic communications system. Authors are Fred W. Bennett, Thomas J. Coleman and John C. Haddock of the Langley Research Center, also reported their findings in NASA Technical Note D-510.

An orbit at or over 900 mi altitude Echo

satellites could be orbited in a single Atlas-Agena E, NASA's Rainbow program scheduled for operation in mid-1963, with multiple satellite launchers with one Atlas-Agena Pro ground orbital altitude for Rainbow at 1,500 mi.

The Langley group studied orbital altitudes ranging from 1,000 to 4,000 mi, maximum elevation angle of line of sight between satellite and ground station from zero to 10 deg and satellite communication time ranging from 99.99% to 100%. Among the conclusions:

- Coverage must be studied in or total altitude because the higher the orbit, the fewer satellites required for continuous requirements and launch vehicle capacity increase with altitude.
- Altitude increase from 1,000 to the 2,500-3,000 mi range reduces the number of satellites required considerably, but the reduction rate above 2,500 mi is much less.
- Since dual communication time must be tolerated because double the

number of satellites is required for 99.9% of service as is required for 99% uninterrupted service.

In order to approximate 90% of the time, according to the report, a minimum of 7.33 satellites would have to be placed in 5,000-mi circular orbits. At a 4,000-mi circular orbit, required number of satellites would be 5.11 at 5,000 mi, the number would increase to 9.15. The number of 2,000 mi would be 12.25 and at 1,000 mi, it would jump to 27.66.

To approximate 99% of the time, satellites required for different altitudes would be: 7,000 mi—14.33; 4,000 mi—5.11; 3,000 mi—4.25; 2,000 mi—2.51; 1,000 mi—2.1 to more than 99.

For their study, the authors listed four ground stations in Newfoundland and Puerto Rico, each located at 96 deg north latitude, 1,500 mi apart.

Rocket-Launched Balloons To Measure Wind Velocity

These small balloons will be launched by Rocket Arms, rocket from Naval Missile Facility, Pt. Arguello in a study of wind direction and velocity at altitudes above 300,000 ft in Santa Cruz, Guam contractor to the Atlantic Range, Commission.

The first of the three launches will occur this month and the succeeding two will be made in April and May. Radar at Pt. Arguello will track the 75-in. Mylar balloons to measure upper atmosphere winds. Deimos Armo is a 17-ft, two-stage, solid propellant rocket.



Saturn Booster Barge Makes Shakedown Cruise

Major problems which will prevent the Saturn launch from Houston, Ala. to the Atlantic Missile Range is shown in a shakedown cruise on the Tennessee River. Several test runs will be held in mid-April. First Saturn booster development flight is scheduled late this year, following a 2,200 mi long trip from Houston to Cape Canaveral.

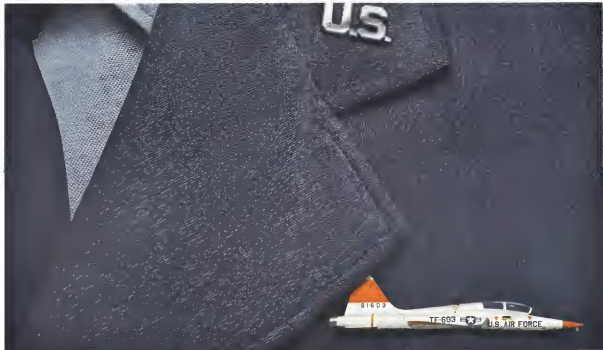


How does it feel to be so young a champion?

In the first six months of its operational life the Air Force's B-57 set six new world speed records and took first place in the high- and low-level bombing event at the 1950 annual SAC Competition. Capable of speeds in excess of Mach 2, the Convair built "Blitz" is more than twice as fast as the next fastest bomber now in service. And it hasn't yet reached its legs. In a few years, fully "grown" the B-57 easily could improve its own performance by ten percent again.

How does it feel to be so young with such promise? No other bomber has ever known.

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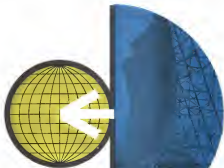


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Now the Air Training Command has a trainer designed for the space age. The supersonic Northrop T-38 is already in service at Randolph Field, Texas. This new jet trainer will school pilots in all aspects of super sonic, multi jet and high altitude flight in a combat air

craft environment. Soon, at first, every U.S. Air Force pilot will learn to fly beyond the speed of sound in the high performance Northrop T-38.

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Okuma-Furukawa Signal Corps Communication Link Completes Pacific System Spanning 400 miles of water, the Far East Barrier System, operated by the Signal Corps, is a highly reliable link in the important Trans-Pacific Barrier System. Alpha personnel engineered the Far East system and provided all site preparations, roads, buildings, antennas as well as the Collins cryptographic machine equipment. Communications of the system passing the significant outposts of Okuma and Furukawa took place under the severe topographic and weather conditions of the cyclone-prone Pacific. Field personnel from Alpha are now working side by side with Signal Corps technicians operating this vital, multi-channel voice, teletypewriter and data communication link.



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NAVY LOCKHEED WV-2 solo barrier plane encounters typical Aleutian landing conditions—bleeding snow. The aircraft is returning from a 10 hr. mission over the North Atlantic. Fuel load for the mission is about 7,000 gal. Flaps, within a 22-inch arc.

Navy Maintains Barrier in All Weather

By Herbert J. Coleman

Aleutia, NRI—United States Navy's busy air Atlantic-wide barrier line from the remote Ketchikan-based base on a 24-hr., all-weather basis despite drastic conditions that often hinder in the violent.

The barrier is an extension of the Des and Pine Tree Lines to a point near the Aleutian Islands but up to 14 hr. Navy has yet to send a barrier launch after four years of operations in which only one plane has been lost at sea and that apparently due to a weather phenomenon.

Title of the main plane remains a mystery, this, via, its own plane and its wreckage was sighted. Radio reports also give no indication of trouble. But Navy officials suspect that St. Elmo's Line, often based in cleared storms, may have played a part in the disaster.

Barrier plane frequently encounter St. Elmo's Line, usually on propeller tips. However, the electrical things in its own case, built in such a way that it can have forced a big hull which reaches down the corridor from the cockpit to the aft and before disintegrating. When St. Elmo's Line shows up on a map and propeller tips, plane crew identify the plane in an attempt to lose it.

One other recent loss at sea—a Navy Air Transport Service plane—also could possibly be attributed to the electrical breakup. The plane, a C-124, was crossing the barrier in radio and radar contact with a pilot aircraft, when

communication ceased and the ship disappeared. Conditions were right for St. Elmo's Line, but no survivors or wreckage were found.

Three questions by the barrier maintaining Lockheed Super Constellation



CONSTELLATION flies over Navy ships during period of not good weather along barrier.

New space radar probes with slivers of light



This is Colidar—a dramatically new kind of radar for satellites and other space vehicles.

Unlike conventional radar, which "sweeps" with narrow cones, the Hughes-developed Colidar probes with incredibly narrow, high-intensity beams of light.

The secret is a new kind of light: *Coherent Light*. This is a progeny of electromagnetic energy at a precise frequency—100,000 times higher than conventional radar frequencies.

This high concentration of energy into a narrow beam gives Colidar amazing powers of discrimination—and enables possible ranges far beyond the abilities of present-day radar.

In orbit, a Colidar-equipped satellite could survey vast areas of space—tracking other satellites, space vehicles and other objects. Add this to Colidar's small size, light weight and low power needs, and the result is the most practical radar for use in space.

Electronics is our business. Developing new kinds of radar is but one facet of Hughes' many activities. Hughes is today building one of the first vehicles which will land on the moon, an astroco-descent as large as the head of a pin and computer-coordinated instrument machine tools.

Perhaps you have a problem for which our 5,000 engineers and scientists can supply a solution. It may be an opportunity for both of us.

Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY

BOEING-VERTOL 107...

THE WORLD'S ONLY

"MISSION MODULE" HELICOPTER

CONVERTS FROM MINESWEEPING TO ASW IN ONE HOUR

The new twin-engine-powered Boeing Vertol 107 is the only helicopter flying today that can perform so many military missions—without costly conversion of the base aircraft. The rear loading ramp and amphibious cargo area provide a variety of modules or equipment to be quickly and easily installed on the 107, thereby enabling it to perform specialized missions for any and all military services. The Navy, for example, can use the Boeing Vertol 107 for minesweeping and fleet utility duties and, then, less than sixty minutes after mission completion, convert it into a subsonic weapons carrier by installing Vertol's ASW module.

Whether the mission, the performance-proved Boeing Vertol 107 offers features unmatched by any other helicopter—550 miles an hour cruise speed, overhead directional ability at zero speed for any wind bearing, a Vertol-developed stability augmentation system (SAS) provides fixed-wing aircraft stability which can be augmented with a trim system for automatic flight—forward rotor control that maintains down-rotor velocities, stability to land and take-off from water without special landing gear.

There are just a few of the capabilities that make the Boeing-Vertol 107 the first all-weather, all-terrain helicopter.



TECHNICIANS aboard the WV-1 can work into sleep cycles. Left: Controls are plotted in the airborne Combat Intelligence Center and relayed to Operations Control Center at Argentina for analysis. At right, crew member operates the height-finder scope.

made ground navigation trials. Cruising was 500 ft and visibility about 1 mi in the water, surprising when taken. The gun Radar's look at about half the runway lights when he called for target power.

The Corsair marked V and V, at 125 kt and lifted off each side. Cal Tech's former chief of this group. Radar was on the ground from 10:00 to 11:00 ft where the Corsair broke into the clear. It was started shortly after the gun came up, but it was not and most flew away on the climb, both were recalled but were not used.

All better weapons are flown at comparatively low altitudes, ranging from 3,000 to 8,000 ft—altitudes compatible with good radar coverage of places at varying heights. In a typical mission, 45 ft, the WV-1 will make as many as 100 contacts finding contact height on water at 100 ft.

For example, Strategic Air Command attempted a mock penetration, known

only to one Navy staff officer at Argentina. Flying at both high and low altitudes, SAC Boeing 8-131 and 8-131 made five attempts to cross the barrier undisturbed. In five cases, they were contacted and tracked by the WV-1 on duty and reported through Navy-Norfolk to North American Air Defense (Norad) at Colorado Springs, Colo.

Radar Equipment

The aircraft is fitted with a General Electric APS-20 language search radar mounted in a plastic radome on the left, and a Philips APS-45 height-finding radar atop the center fuselage. Scopes and indicator units are mounted in a dedicated area in the aft section and weathered constantly.

Radar surveillance starts at the last moment when the plane commander sends an "Open Radar" signal to the Argentina Operations Control Center which runs a constant plot on WV-2

positions along the barrier. A radar contact once plotted for course, speed and altitude, is given a "Flash" message promptly and is followed up with additional information in a regular message stream.

At Operations Control, the decision is made as to whether to consider the contact an "unknown." It is checked against known commercial and Military Air Transport Service flight plans, and if data does not indicate, the contact is sent by hot line telephone to Norfolk Control. Norfolk is connected directly with Norad and final decision for a suitable interception is made at Colorado Springs. The scramble can be launched in less than 10 min from time of the first flash advisory from the WV-2.

Contacts are plotted directly on search and height-finder scope. The flash report, besides immediate transmission to Operations Control, is plotted in a replica of the barrier and



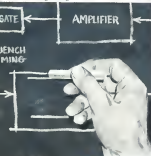
RACHIDE OFFICERS' QUARTERS at Argentina is known locally as the "Argentine Hilton." Reception facilities include a landing strip and generator. Top floor primarily is used for married officer's temporary housing. Aerial view at right shows runway layout.



Field Service Engineering



Replacement Parts



Customer Training



Factory Repair and Modification

A NEW COLLINS DIVISION EXTENDS A HELPING HAND

Collins Radio Company's new Service Division is providing Collins customers throughout the world with the finest in maintenance and technical support. Operated to complement the service responsibilities of all Collins engineers and technicians in use, this Service Division is working a substantial contribution to Collins' goal: maximum reliability and maximum down time for Collins products.

The Service Division is staffed by specialists in Field Service Engineering, Factory Repair and Modification, Parts Procurement and Technical Training.

For details on how Collins Service Division can help you, contact the Service Division, Collins Radio Company, Order Supply, Iowa.



in course monitored by the cat's time the log is set. A ground computer also shows the WV-2's position on the horizon.

In addition to radar, the WV-2s carry electronic countermeasures equipment, which excludes nuclear from other radar sets, both airborne and surface. In some cases, the WV-2s have picked up airborne contacts through ECM, and as a previous run. Col. Forchtmeyer orders a low-level reconnaissance run to check out an ECM section. It turned out to be from a Canadian bomber, and the crew is still looking for its first intercept.

With such long flights at almost constant headings, for considerable periods of time, the problem of crew boredom becomes primary. To combat this, the crew often exchanges jobs, i.e., the pilot will navigate, navigation man radar and the like.

In addition, airborne emergency drills are called without warning. On this particular flight, Col. Forchtmeyer ordered a drifting drill when the aircraft was on a GCA approach to Augusta. Drifting was simulated for touchdown and the crew was well into position. Actual abandonment, emergency equipment was made at the alert hangar. To ensure competence, May keeps an observation team at the ready to pull spot checks on various items. The team usually shows up at landing time without advance warning.

The particular horizon run was made in a counterclockwise direction and the item was made at a point near the horizon, where Laga is the horizon line. As the horizon plane is "leveled" off the horizon for landing. This happens when weather conditions are critical at Augusta, or in related cases when a crew is looped into Laga for exit and recreation, of which there is little at Augusta and not much more at Laga.

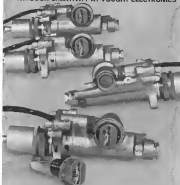
The loop is worked on by Operations Control and when the crew can remember leaves Augusta, he never leaves exactly when he will be back, the 22-man crew cannot complete clearly the changes on one mission.

Once airborne, the crew's duties are rigidly controlled to allow each crew member to perform his role in the radar section where scope scanning can be visually rehearsed. The WV-2 has a well-equipped galley and at least one hot meal, prepared at Augusta, is served on duty. The coffee, in Navy tradition, flows constantly.

About 12 hr after liftoff, Col. Forchtmeyer was alerted from the horizon and headed inland for a GCA approach, a common occurrence. Ceiling was about 400 ft and visibility about 15 mi, but the crew again had to put up with another common weather problem—icing on the ra-

RELIABILITY

THROUGH CREATIVITY AT VOUGHT ELECTRONICS



CHALLENGE: Provide the most reliable actuator ever built for use in the Minuteman ICBM.

RESPONSE: Vought Electronics—working with four valve producers*—unpacked the standard electro-hydraulic valve to achieve maximum reliability. The number of external seals was reduced. Seal configuration was made more reliable. Temperature shock sensitivity was lowered. And the finished valve—of all-metal construction—weighed less and had fewer parts than standard service valves. This is just one of the many ways Vought Electronics has improved actuator reliability.

*Mott Servotronics, Inc.; Raytheon Aircraft, Inc.; Weston Hydroflex, Ltd.; Hydroflex Research and Mfg. Co.

FOR A CREATIVE APPROACH TO YOUR CONTROL RELIABILITY PROBLEMS, CALL OR WRITE VOUGHT ELECTRONICS' NEW PLANT AT THIS ADDRESS:

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Our first Astronaut will be aided by an instrument designed to provide visual monitoring of his automatic re-entry equipment. The device is a product of the creative design and engineering skills of Honeywell. Components for it are being supplied by the Honeywell Precision Meter Division.

Maybe you have a mechanism problem that's looking for a solution. A quality product from Honeywell may be the answer. Just get in touch with our representatives in your area—he's listed in the classified pages of your telephone directory. Or contact us: Honeywell Precision Meter Division, Minneapolis-Honeywell Regulator Company, Manchester, N.H., U.S.A. In Canada, Honeywell Controls Ltd., Toronto.

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H Precision Meters

was. The Conestoga is fitted with poppet valves and, despite the ice, stopped well short of runway 2. Detecting that the C-119 No. 2 had made 17 contacts, of which height finding was obtained on 11. A check with Operations Control showed that the 17 contacts yielded out to 100% illumination by WV-3, that were in places substantiated by contacts from other WV-3s and surface vessels.

The WV-3 was traced directly into its hangar bay where VS-13 maintenance crews checked the flight report for errors. No major maintenance is performed here, but spare engines are available and can be installed in short order. Maintenance on 108 hr inspections is performed on planes assigned to VS-11, the Argentine squadron, and the Patuxent River squadron refuel their planes back to base base for 100 hr checks there.

However, all WV-3s are sent to Lockheed Air Service, Inc., at New York's Idlewild Airport, for 400 hr checks, run on what Lockheed calls an "isolated maintenance plan" first developed for commercial air carriers. This allows a complete inspection cycle to be performed in 7,200 hr, with engine clearance kept to a minimum. The 400 hr inspection takes from 7 to 10 days and the plane is returned to service at Argentina.

So for Lockheed Air Service, has provided two-fold maintenance service; a considerable amount of this is spent on Argentinian aircraft, of course. At specified times, at Navy request, Lockheed performs on Navy requests of stress points to detect possible damage. This is all possible value because of corrosion factors which enter into the Argentinian operation, in all-weather flying.

Before a crew assignment, extensive training is conducted at Patuxent River. A crew commander, for instance, must have 1,000 hr maintenance time and 250 hr in WV-3s before getting a barrier assignment. As things work out, crew commanders usually have 5,000-8,000 hr, in each operational squadron, most first pilots are of commander rank. Each must have a gross instrument and 15,000 hr total time, plus five years and six months.

Although barrier flights are the primary mission at Argentina, there are a number of other duties. The PTV squadron flies extensive ice patrols, under international agreement, in and out of shipping channels, in clearing flow of shipping.

Aircrew lost of this mission is surveillance and plotting of surface vessels, there are often as many as 2,000 operating in the patrol area, and many of them are Russian built. Most of the Patrol and Maritime



LOCKHEED P-3V, one of 11 based at Argentina, works with Royal Canadian Air Force in clearing surface vessels and ice flow. Canadian used the Canadian Argos.

and of fishing and supply vessels.

The P-3V also has night vision capability of the Soviet "Z" class, which provides extra two inches in the aft viewing range. The sightings, the instrument crew says, that involve work range of the sub-carson five before aerial operations.

The 11 plane PTV squadron usually operates at low level, again as all weather conditions. Night hours is also the standard, in flying with surface-mounted in range nearly 100 ft above surface of the water.

Argentina has a single Sikorski H-19 helicopter, and search and rescue. In recent weeks, the aircraft has been used to cut and collect trapped in rugged terrain by snow and ice. On one mission, the H-19 flew 10,000 ft of hold in an isolated community in danger of starvation. Later a man and two children, all severely ill, were flown from the village and sent to Patuxent Cottage Hospital, Patuxent River, within two hours of submission.

PRODUCTION BRIEFING

Lea Electro-Mechanical Division has won a \$4-million contract to continue production of engine test and fuel systems for check, was control and flap control F105 aircraft. Contracts for the system now total \$15 million.

General Electric Minsk and Space Vehicle Department has an \$15,000 contract to produce test water nitrogen system to produce possible drinking water from human urine.

The Aero-Electric Research Laboratory has been awarded a \$375,000 letter contract by Bell Telephone Laboratories for an experimental study of a three-dimensional system for the Nike-Pan atmospheric search. The study will center on means of identifying the close proximity of radiation control from objects entering the atmosphere and the development of optical warning apparatus.

Seawoods Precision Products, Inc., Taunton, N. Y., has received more than \$1 million in contracts for fuel gauges for the General 990, Sea-Cure 100, Lockheed P-3V-1, Chance Vought F4U and General CP-104.

First Messing-produced Lockheed Argentinian plane, has made its initial flight at San Juan Porton plane, 100 mi south of Mexico City.

Republic Aviation Corp. has been awarded a \$175,000 Air Force contract for the development of extrusion process for titanium metal.

Chrysler Corp. has been awarded a \$400,000 contract for development and maintenance on the Army's Redstone missile. The work will be performed at Chrysler's Michigan Ordnance Missile plant Sterling Heights, Mich.

Radio-Astrak, Inc., Cambridge, Mass., will conduct a shakedown testing program for the Marsden and Space Division of Lockheed Corp. in connection with the Marsden program module tests of a \$1 million contract.



Remote stations detect storms caused by lightning. Incoming data are transmitted to central station.



At central station data from remote sites are triangulated and displayed.



Flashes of light in atmosphere indicate lightning's location.

Now... Forecasting by Lightning

New Lockheed Electronics weather system spots storms up to 2,000 miles away

When a storm is brewing, lightning may send warning hours before it is detected by weather radar. Lightning flashes (strokes) give valuable clues to weather conditions, but until recently, weathermen had no effective way of detecting and locating strokes at long range.

Now, Lockheed Electronics has produced, in conjunction with the Army Signal Corps and Air Force, a unique system that pinpoints all lightning flashes within a 4,000-mile area.

Remote stations pick up radio signals generated by storms. Processing equipment converts the signals into directional data and transmits the information to the Air Force's Severe Weather Warning Center in Kansas City, Missouri. There, after triangulation, the signals are traced on a display which gives the storm's location and path.

Continuing research is leading to use of strokes as an aid in forecasting tornadoes and for plotting severe storms in mid-ocean where present forecasting devices cannot be used.

LEC is contributing importantly in a variety of ways to development of equipment to advance meteorological knowledge. Among current projects are high performance radarscopes and wind data conversion systems.

MINDING THE FUTURE

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THE VOICE OF THE "FIREBEE"



Firebee is precisely measured by radio telemetry as it soars. Eight data transmitted from Dorsett telemetry system in the drone.

Ryan uses airborne telemetry systems by DORSETT



Ryanco's Ryan B-2C "Falcon" Target Drone provides a fast, high-speed, reliable target simulating threat target. Rugged and available for reuse, the "Firebee" is easily guided the "real" fire on airborne vehicles and surface-to-air missile systems.

Firebee can be precisely controlled from airborne or ground stations, also in addition to radio tracking data, height, air speed and altitude are transmitted continuously to the controller by the Dorsett Model M-31 system.

When additional data is required for mobile development programs and special applications, the system may be expanded to a total of ten telemetry stations in the gun wind chain.

The Dorsett telemetry system is one of the many designed and built by Dorsett Electronics. For Dorsett's experience to work for you on your next telemetry requirement. Your inquiries and specifications will receive a prompt reply.

DORSETT ELECTRONICS, INC.

P. O. Box 862 • Norman, Oklahoma • Jefferson 4-3730



AVIONICS

Non-Semiconductor Format Guides Set

By Barry Miller

New York—Another important step in defining a set of compatible formats for microcomputer system components was taken here recently at a meeting of system designers who will be specifying their new generation of computers for future microcomputer digital data processing systems.

The meeting was the final one under the present name for the so-called Sub-committee on Microcomputer Component of the Electronic Industries Assoc. (EIA). In recognition of the anticipated widespread use of microcomputer components, EIA has altered the subcommittee to the status of an advisory committee on user recommendations for digital microcomputer components.

At the current meeting, the committee launched out a recommended set of formats for non-semiconductor components. At an earlier meeting (AV Sept. 5, p. 90) it had agreed to similar formats for semiconductor devices. These recommendations, which, the committee hopes, are now standards in each-one to be submitted for study by respective industry groups for possible adoption as future standards.

Nonstandard elements by component manufacturers, under review in the group have claimed favorable responses from several computer parts makers. A number of those who were in the process of introducing lines of microcomputer-related their component formats to comply with the select-without's demands.

Committee Members

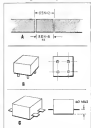
Presently, the committee comprises representatives of a broad group of aerospace systems manufacturers—including American Bosch Air Corp., Hughes, General Electric, Raytheon, Westinghouse, Litton, Lockheed, Boeing, Autonetics, and Collins—which originally led the task of developing recommendations for component formats consistent with the needs of potential digital data processing systems. In the future, the composition and scope of the committee will be enlarged so it can make user recommendations for microcomputer components to be used in other fields such as control and communications. Digital system designers who have been participating in the group's deliberations during the past year are certain that future microcomputer components which they still need will be available

in standard formats from sufficient sources so the user can be assured of quality supplies of given components in the correct form and shape for one-time, lightweight, mission systems. In fact, the committee's design team to advance the format of the serial connector types of components used in any given field—such as digital data processing—is the point where the serial wiring—such as any type of component are not embedded in the large volume and weight of computer components.

An important probable consequence of the use of recommended formats will be an automated assembly.

Similar sizes and shapes for a variety of components such as transistors, diodes, surface capacitors and inductors, might considerably simplify an effort to automate assembly of entire systems.

The recommendations is discussed at the recent meeting are to be made printed in a complete report which will be presented for the group's approval at an next meeting to be held in Los Angeles during the Western



TECHNICAL section formats for microcomputer systems components recommended by committee of various engineers. Packages for resistors, capacitors and inductors are not to exceed 64 mils in height and should be integral multiples of 25 mils in other dimensions. Package in diameter is a hole of not over 64 mils (A). Pin locations and dimensions of single and double-ended pin connectors on (B) and (C) would conform to 25-mil grid system also.

East Computer Conference in May. There appeared to be a consensus among members present on the following points, among others:

- **Surface-mount component format.** A uniform format for micro resistors, capacitors and inductors suitable for surface-mount holes in a printed board as a substrate is desired. Components will be a maximum of 60 mils in height and integral multiples of 25 mils maximum in length and width or diameter. Where leads are employed it is suggested that they be ribbon-shaped and comply with the two further of the component. Thermal resistance would be permeable; on the component and an eight-inch tolerance between a component and the hole is anticipated to encourage capillary action during soldering.
- **Capacitors—high-voltage parts.** Will range in value from 25 to 1,000 picofarads and from 0.01 to 2 microfarads. Working potential should be 50 v d c.
- **Resistors—Value desired will range from 100 ohms to 100,000 ohms with the high-value values expected to be between 2,500 and 5,000 ohms.** Electrical characteristics are not to change more than 5% in a 100°C temperature change. Frequency limit for resistors is to be 50 megahertz. Power rating specifications to be supplied by the component maker should provide information about the maximum temperature limit of the component for a given type of reliability.
- **Pin and solderability.** Gold will be needed in solder up to 25-mil thickness.
- **Pin location.** Single-ended pin connectors with lead as pin attachment for surface-mount holes in a printed circuit board should have dimensions and lead locations compatible with a 25-mil grid system. Double-ended pin connectors should be attached for partial solderability in a substrate or lead hole should have a hole. Maximum depth from one surface, compliance with the leads to the leads should not exceed 64 mils.
- **Connectors.** Extreme specifications were outlined for connectors and their will be supplemented by additional data to be obtained from another EIA subcommittee concerned specifically with connectors. All dimensions are to be referenced to the 25-mil grid system, including over-the-assembly dimensions on contacts, body dimensions and mounting dimensions. Ratings for contacts on 100, 10 and 25 mil centers are



Computer-generated laboratory model of pilot's display of aircraft landing sites within the limits of safe velocity.

FAST THINKING for spacecraft pilots is the development objective of the Bendix Energy Management System Project being carried out for WADD, ARDC, United States Air Force. By means of an airborne computer-operated electronic display, a pilot will see the continually shrinking area of targets and landing sites which he can reach without exceeding the acceleration or heating constraints of safe flight. Career opportunities in such advanced projects are available to engineers who would like to direct their energies most effectively.

BENDIX SYSTEMS DIVISION
ANN ARBOR, MICHIGAN



0.5, 0.4 and 0.3 amp maximum and 0.02, 0.01 and 0.04 ohm maximum, respectively. Voltage breakdown between contacts should not drop below 100 v. rms for the 25-mil contact, 150 v. rms for 34-mil contact and 200 v. rms for 100-mil contact.

Gold-plated areas are recommended for leadless components so that solder ducts can be soldered to them. In some cases a physical indication of polarity must be required but it was noted that it should not be made in a way which might be blurred or destroyed during cleaning or assembly.

More components which at least in some respects, conform to the forecasts recommended by the RFA committee are beginning to appear in increasing numbers. Many of these, available as surplus products or on special order, were displayed at the recent Institute of Radio Engineers Show. Among these are components from:

- **Bartholomew-A** line of 33 silicon and germanium transistor electrically equivalent to other devices available in TO-18 cases. Germanium units are available in 1/8-in. diameter x 150-mil high cans while the silicon units are in smaller cans, 150 mils x 180 mils in height. Lead wires extend axially either from the header or in some cases two leads extend from the header, the third through the top of the can.

- **Macomex Associates-Dallwood** silicon mesa diodes, have a hard glass or enamel bond to the semiconductor junction. Diode is 90 mils in length, 60 mils in depth, has low leakage current and an allowable junction temperature of 200°C.

- **Clevite-A** line of glass-sealed "mils-miniature" germanium diodes, 90 mils diameter, 160 mils in length, are being made on vacuum assist.

- **General Instruments**—Microelectronically sealed glass, planar diodes, equivalent to Fairchild's F100. Characteristics of these units include forward conductance of 10 millimhos at 1 volt, 2 megohms reverse ratio, and 2 picofarad capacitance at 200C.

- **Transistor-T**—Transistor has a local line of silicon transistor and diodes built within the forecast recommended by RFA committee. This includes epitaxial silicon switching transistors, high cut-off frequency silicon diodes, fast switching silicon diodes, voltage regulators and resistors. Among the more recent additions to its output component line are source Zener diodes.

- **Mocon Corp.**—Continues expansion to fit 200-mil modular spacing.

- **California Resistor Corp.**—Woven-wire power resistors, 4 in. in length x 0.12 in. in dia. become available in force but was not displayed at the IRE Show. Resistor has 1-watt power rating, temperature coefficient less than 0.0001%/deg. C.

NEW AVIONIC PRODUCTS

- **Microminiature silicon indicator meters** are 0.375 in. dia. by 0.50 in. long, are used as nullification indicator, zero-center or beam readout. Units can be supplied to operate from an standard 4 or 100 cps a.c. voltage. Price is



approximately \$100 each. Weight is 3.7 grams. Solenoids which operate indicators are designed for use over temperature range of -55° to 160°F. **Mass Instrument**, Duro Instrument Co., Tyler and Pierce Streets, Brooklyn 1, N. Y.



MODEL 80-33
Threaded Case Type



MODEL 80-32
Threaded Housing Type

- **Microminiature trimmer pots**, with resistances ranging up to 20,000 ohms, are designed for flush panel mounting. Model 50-5-5 has a 1 in. x 12 threaded case and mounts within the panel with only 3/16 in. protrusion from it. Model 50-5-2 is 1 in. x 10 and has a 10-12 threaded bezel for panel mounting. Resistance tolerance is 5% and power rating is 1 watt at 50C. Unit package 80 mils in length and 40 mils diameter, are mounted on units with in excess of 10 and 300 ohms



- **Seleniometer selenoscopes**, Type LA 800, are push-on with constant damping, measure 1 in. dia. by 1.25 in. long, weighs less than 4 oz. Range of scale deflection measurement is 1 to 100% with resolution better than 0.0001%, according to manufacturer. Non-damped damping ratio is 0.65, ± 0.15 , over a temperature range of -50° to 210°F, but is available with other damping ratios to meet customer requirements. Variable area film coupling is used to maintain damping ratio fixed over the wide temperature range. **Manufactured by** Minneapolis-Hovencell, 80 14th St., Boston, Mass.

- **Tunnel diode amplifiers**, Model G17-150, capable of receiving external input signals in the 750 to 500 mc range, can resolve a time figure of a 1.5 ds. As phase shift, the device includes center-frequency, spectrum analyzer, broadband telescopes, broadband cone microscopes and high-deflection beam bend radio systems. **Manufacturer** Micro State Electronics Corp., 152 Flood Ave., Menlo Park, N. J.

- **Silicon mesa diodes**, Type TH and TH-6, hermetically sealed within glass package 80 mils in length and 40 mils diameter, are mounted on units with in excess of 10 and 300 ohms



each, respectively. Mass values of these micro-miniature diodes are available from Manufacturer Texas Instruments, Inc., P. O. Box 5012, Dallas 22, Tex.

This is systems capability at NAA-Columbus

Assembled at the Columbus Division of North American Aviation are the facilities and the proven technical intellect to bring original concepts swiftly to practical production by the most economical and efficient methods. Here, in one of the most complete centers of advanced systems technology in the world, many of the important advances in electronic, electromechanical, and environment systems, as well as other areas, have been made. This is true systems capability...this is the Columbus Division.

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.
Columbus, Ohio



RIGHT ON AIR: The Mach 2 A-1H Vigilante, now being built for the Navy at Columbus, operates effectively at deck level or up in the stratosphere. The versatile A-1H can perform either attack or reconnaissance missions in any weather, at any altitude or altitude, day or night.



VARIABLE FACILITIES: The Free World's layered wire turned for the study of transformers from orbital to low flight is a part of the facilities at Columbus. Other V-870L equipment includes air-speed-of-flight simulators and air-altitude, air-speed escape systems.



Q. HEAT: Columbus developed a major "Q" unit to study human tolerance to a high degree of vertical acceleration and to make human factors in the machine. Advanced low-level high-speed escape systems and pilot response in those flight regimes will be studied with it.



PARABOLIC ANTENNA: An old-world type of antenna, constructed to suit present technology that it will be used to exact parts, will be built by NAA-Columbus for the Air Force on "Hawstack Hill" near Tuscon. More unique designs developed at Columbus allow the vital specifications to be met with significant reductions in dead weight, and in control power requirements.

00000 FILTER CENTER 00000

► **New Thermoelectric Materials Revealed**—New group of high-temperature thermoelectric materials, increases voltage and current yields, which can operate at temperatures as high as 2,000° have been developed by Westinghouse Electric under Navy Bureau of Ships sponsorship. Although not yet as efficient as low-temperature materials, the new rare earth solids can be used as happens in a series of thermoelectric elements permitting operation at higher temperatures which yield higher over all generator efficiencies.

► **Automatic Deburring Speeds Gun Fabrication**—Eclipse Power Division of Bendis, which builds the actual guidance system for Pershing ballistic missile, reports that it has automated the deburring of gun parts, formerly done by hand under a 20-power microscope, cutting time required from eight hours to only an hour.

► **Precision Connector Meeting Scheduled**—A one-day meeting on high precision connectors, which will discuss ways to reduce errors in precision measurements due to connector irregularities in critical equipment at radio and microwave frequencies will be held June 29 at the Boulder Laboratories of the National Bureau of Standards, Boulder, Colo. Abstracts of papers should be submitted by May 1 to R. C. Powell, NBS Laboratories in Boulder.

► **High-Power Static Inverter Developed**—A solid-state inverter, capable of delivering 50 kw, has been constructed by General Electric's General Top Research Laboratories in Schenectady, N. Y. Inverter, which employs silicon controlled rectifiers, operates from 115 v a.c. and delivers three phase 120 to 140 v a.c. power at a frequency which is adjustable between 50 and 500 cps.

► **Military Antenna Market Surveyed**—Market survey of military antenna manufacturers by Robert C. Schreyer & Associates, indicates that current year sales will total between \$150 million and \$170 million. Antenna market in this year is expected to grow to \$400-\$600 million.

► **Long Range Telemetry Developed**—New long-range telemetry system, called Swathtrak, developed by General Electric's Missile and Space Vehicle Dept., is expected to have a range three times that of any telemetry system ever flown, compares Geo. Swathtrak is a digital telemetry system employing radio wave modulation with phase shift keying (PCM-PSK).

The background is a dark, starry space. On the left, a stylized rocket engine nozzle is depicted, with a series of smaller, similar nozzles trailing behind it, suggesting motion or a sequence of designs. In the lower right, a series of pocket watches are shown, with the largest one in the foreground displaying the equation $E=mc^2$ on its face. The watches appear to be moving or changing, symbolizing the progression of time and technology.

FACING THE FOURTH DIMENSION IN PROPULSION DEVELOPMENT

Whether the universe has a "round" shape, or any shape at all, is a matter of interesting conjecture. The matter of space travel, however, is the subject of intense experimentation. A nuclear/thermosc/zonic propulsion system, currently being studied at Lockheed Missiles and Space Division, might well become the power source for space vehicles.

Its design incorporates a nuclear reactor only one foot in diameter, generating heat at a temperature of 3850°K. This is transferred by tanks of thermionic generators, converting the heat directly into electrical energy for the ion beam motor which uses cesium vapor as a fuel. The entire system is designed without any moving parts, minimizing the possibility of failure.

Lockheed's investigation of propulsion covers a number of potential systems. They include: plasma, zonic, nuclear, unique concepts in chemical systems involving high energy solid and liquid propellants, combined solid liquid chemical systems. The fundamentals of supersonic/hydrodynamics, as they might eventually apply to propulsion systems, are also being examined. Just as thoroughly, Lockheed probes all missile and space disciplines in depth. The extensive facilities of the research and development laboratories—together with the opportunity of working with men who are acknowledged leaders in their fields—make association with Lockheed truly rewarding and satisfying.

Lockheed Missiles and Space Division in Sunnyvale and Palo Alto, on the beautiful San Francisco Peninsula, is an exciting and challenging place to work. For further information, write Research and Development Staff, Department M-24D, 962 West El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

Lockheed / MISSILES AND SPACE DIVISION

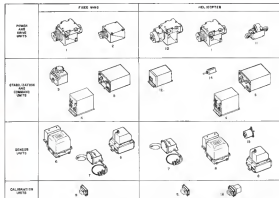
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BASIC UNITS of manual automatic flight control system: alt, roll, pitch and yaw power units (1); trim power unit (2); flight controller (3); altitude reference control (4); longitudinal control (5); altitude control (6); calibration unit (7); pitch and roll power unit for helicopter (10); linear actuator (11); collective pitch manual control (12); trim switch (13); command pickup (14) and spin sensor (16).

V/STOL Control System Design Unveiled

Phoenix, Ariz.—[Details of a manual automatic flight control system which will provide stabilization and control functions for the Army's manned free-flying and retrieving aircraft and for prototype drones are disclosed here by the Space Phoenix Co.]

The system, designated AN/ASG-120V, can maintain an aircraft's position to within 1 deg. of a desired attitude, sufficient for Army aircraft reconnaissance or side-looking-radar mission systems, developed under contract to Army Signal Research and Development Laboratories, is intended to be usable with only minor changes on a wide variety of Army aircraft, including latest high-performance V/STOL aircraft.

Universal systems of this type were installed and flight tested in a series of military aircraft including the Vertol H-12 and Sikorsky H-37 helicopters and the Beech L-200. Production versions are now going into the Grumman A-1H Hawk; others are slated for the

de Havilland DH8C-4 Cymbay and possibly the Vertol YHC-1B Chinook helicopter. This universal stabilization is provided for free-flying aircraft, as to free-fall (roll, pitch, yaw, altitude and rotor speed control) is provided for helicopters.

System Flexibility

Flexibility in the system comes about through the use of a common series of component units, or modules, interchangeable from aircraft to aircraft. The modules are so designed that they can be installed with only minor adjustments in a system into a variety of aircraft types. For use in helicopters, basically the same components, supplemented by several additional units, can be integrated into a rotor-wing flight control system.

This universal characteristic—a minimum number of interchangeable modules suitable for use in cross aircraft types—is the source of important advantages for military aircraft. It even en-

ters, cuts down on technician training time, simplifies logistics and lowers inventory carrying and handling. A free-flying three-axis system with a 1-g payload coupling weighs 40 lb., while a four-axis helicopter system weighs 54 lb.

Functions which can be provided in the system are:

- Altitude stabilization (pitch and roll)
- Heading stabilization, including a heading select function
- Altitude stabilization with control provided by barometric, radar or glide path inputs
- Pitch guidance with crosswinds accepted through a coupling device from automatic navigation equipment such as display radar, ILS or VOR
- Engine rpm control (for helicopter only)

In designing the system, Space engineers abandoned the classic integrated concept with its multitude of inputs and outputs and attempted to make each module of the system functionally independent. Hence, the idea of



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SWINGING below Army H11 helicopter is a 600 lb. load saving in a position during tests of Army-Sperry Phoenix universal flight control system in the Desert Area Sperry plant in Phoenix.

grouping all tubes or transistors required for control of the aircraft's three flight axes into a single package for convenience of shock-mounting—highly a surprise from gun-transistor design—was discarded. The slider approach meant that servo amplifier and motor for a given axis were packaged separately. Larry Kaufman, engineering project chief on the several control systems, points out:

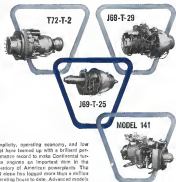
Instead, in the Army-Sperry approach, the entire servo system for each axis is grouped in a single self-contained low-power package. This unit is common for each axis and for all aircraft, and even such axis differs from another by a small external plug-in calibration unit (operating voltage-capacitance) external for adjusting attitude time and rate of attitude error output. This approach, Kaufman says, also supplies redundancy so that amplifier and servo can be tested and tested together.

Components of the system are grouped by their functions into four general types—power and drive units, valve/actuator and command units, sense units and calibration units. The nature and the number of units required, and where they might be located is a typical function system, are shown in an accompanying drawing of an L-23. In the following installation, power and drive units accept electrical commands from instrumentation and command units, then mechanically position the aircraft's control surfaces. In a helicopter, power and drive, and a sensor (commanded pitch) are mechanically connected to helicopter attitude, collective pitch and cyclic throttle controls. Servoactuators, command and sensing sense units are tied to power and drive units.

The relationship of components for

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Simplicity, operating economy, and low cost have teamed up with a brilliant performance record to make Continental turbine engines an important item in the inventory of American powerplants. The J69 alone has logged more than a million operating hours to date. Advanced models growing out of the J69 program open new industry applications. They include aircraft turboprops of 1,100 and 2,600 hp thrust, "off-the-shelf" turbofan engines of 2,800 and 4,800 hp thrust, a large-turbine turboprop of 3,500 hp thrust, attitude thrust magnetron devices for missile turbofans, and the J69-T-25 air pump for boundary layer control. Rounding out Continental's capability in the field of aircraft propulsion is a completely new series of turboprop and turbojet engines, including the 100-hp, 6,000-rpm T17-5A (U. S. Navy designation T12-T-3) turboprop, which promises to find use in a wide variety of applications.



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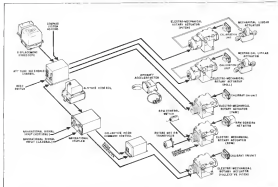
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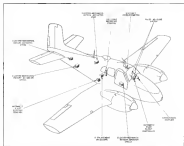


BASIC COMPONENTS of helicopter version of Aerojet-Phoenix Co. inertial flight control system. Heavy black lines indicate direct control relationship; other lines double-dot broken, able to provide pitch, roll and yaw, roll, pitch and yaw rate control, weighs 94 lb.

The following system is shown in an accompanying signal flow diagram. Signal flow divides into pitch, roll and yaw control channels. The system is activated when electrically operated relays connect the power units to the inertial control system. Signals from the sense units, stabilizers and command units and navigation aids provide attitude and heading stabilization, attitude control and/or automatic path guidance depending upon selected operating mode. Although control channels are electrically independent, operation of the roll control channel for command of banked turns is coordinated with the yaw control channel for turn coordination.

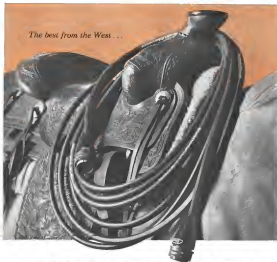
Operation of a typical control channel for the pitch channel, for the fixed wing version is as follows. Pitch attitude of the aircraft is controlled by the pitch power unit's positioning of the elevator control. The pitch power unit accepts signals from these sources:

- Vertical gyro, which measures the aircraft's pitch attitude.
- Cockpit-mounted flight controller—signals from controller are converted by attitude change command to pitch.
- Attitude control measures change in horizontal attitude.
- Radar altimeter measures change in



TYPICAL LAYOUT of basic components in modules of Aerojet-Phoenix inertial flight control system is shown in this drawing of a B-57C. Inertia has been successfully tested in several Aerojet aircraft and is being produced in quantity for installation in at least several Army fixed wing aircraft and helicopters. Modules are interchangeable from aircraft to aircraft with only minor adjustments to form basic three-axis flight control for fixed wing, inertia control for rotary wing.

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under attitude from a selected attitude.
• **Glide path** liquid sensors, deviated on attitude between the aircraft's path and the approach glide path.

Vertical gyro and flight controller signals maintain the attitude at the desired pitch attitude. Both signals are fed to the pitch control channel of the attitude reference control. The vertical gyro signal is compared with a reference, while the flight controller signal changes reference attitude at a fixed rate in a nose-down or nose-up direction, as the pilot advances or retracts a knob on the controller. Differ-ence between reference attitude chosen by the pilot and actual pitch attitude sensed by the vertical gyro are then fed to the pitch power unit which produces the elevator to null the difference.

Desired attitudes can be maintained by signals from several sources. The pilot operating a vertical select switch on the control panel of the navigational computer through which all attitude signals pass to the pitch control channel selects the source of attitude control: compass-tide attitude, glide path receiver or hemispheric pressure reference. If he selected the hemispheric attitude control fraction, for example, signals would be fed from the attitude control through the navigational computer to the pitch control channel. These would command changes in pitch attitude necessary to hold constant hemispheric attitude. Similarly, glide path and radar altimeter signals can control approach or cruise attitude.

Power Units

Principal parts of the flight control system include:

• **Power units**—Power units (one required for each one of both longitudinal and lateral) convert an attitude signal to the gyro motor and power transducer. Each is a \$530 package, designed electric-mechanical rotary assembly for the Navy. They are regulated by Sperry as the heart of the system. Each power unit consists of a transducer amplifier, an attitude and down and backset assembly. They are capable of receiving direct commands from the pilot or automatic navigation, external and computer action signals to hold each command.

The package is designed so that the accelerometer and the remainder of the drive assembly, as well as the attitude assembly, can be pulled out by removing captive screws in the case. This is done without disturbing the rest of the rigging of the aircraft and leaves only a clean housing and gear attached to the rigging. Operatively, the unit converts electrical error signals into rotary motion of its cable drive to move control surfaces of the aircraft.

• **Trim power unit**—Trim power output is applied through rotary motion of an



Altitude



Heading Indicator



Turn and Slip



Rate of Turn



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Flight Propulsion NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company



Convair Hustlers Smash Six World Speed Records

Log Top Speed of 1430 mph

EDWARDS AFB, Cal.—Six world speed records. Five of them Hustler-held, were easily doubled here recently by two Convair B-58 Hustlers from SAC's 43rd Bomb Wing.

The Hustlers were powered by General Electric J79 turbojet engines, which have now helped set 16 world speed, altitude and payload records in little more than a year.

A B-58 piloted by Maj. H. J. Dorn set a new record: 1051.8 mph while carrying a 3000 kg (6600-lb) payload over a 1000 kilometer closed course. The record claim, which is over 450 mph faster than that previously held by a Russian Tu-16, was also noted for the no-payload and 1000 kg payload categories.

Two days later another B-58 swept over a 1000 km course at an average speed of 1248.7 mph. Records were claimed for the same three payloads. The Hustler, piloted by Maj. H. E. Cooley, logged a top speed of 1430 mph during the run.

The previous 1000 km record was held by an Air Force F-101, Voodoo, in the no-payload class, with 799.5 mph, and by Russia (1039 mph), in the 6000 and 2000 kg categories.

B-58 AWARDED THOMPSON TROPHY

WASHINGTON, D.C.—The Convair B-58 piloted by Maj. H. E. Cooley was awarded the coveted Thompson Trophy in late February for its record-breaking closed course speed of 1430 mph.

It is the first time in aviation history that the trophy has been won by a heavy bomber. The award is presented annually by the Air Transportation Council.



One of SAC's remarkable B-58 flight crews checks fuel flight plan prior to takeoff. This 27thousand Hustler logged a top speed of 1430 mph during its run.

Nuclear Flight by '65 Is G-E Program Goal

CINCINNATI, Ohio—Nuclear-powered flight by 1965—or even sooner—may be possible and practical, according to David F. Shaw, general manager of General Electric's Aircraft Nuclear Propulsion Department.

Since January, 1956, we have successfully operated modified J47 turbojets for hundreds of hours on nuclear power," Mr. Shaw said. "We have also successfully completed experimental tests on advanced reactors, and are now designing a high-performance nuclear-powered turbopump for flight testing in the mid-1960's."

"Full-scale turbojets specifically designed for nuclear power have also been operated hundreds of hours in test cells on electrical loads. They have met or exceeded all performance estimates."

"It is no longer a question of *can* we build a nuclear-powered aircraft engine, but when we can place such an



Proposed General Electric J47 turbojet

engine in an aircraft," Mr. Shaw said. "We have reached the point of saying that when we achieve it, really, we can have the dual-use cycle nuclear turbojet ready for installation."

One example (model GE4-7185) of an engine like further information on G-E's aircraft nuclear engine program.

SAC Hustlers Complete Six Months of Operation

CANBERRA, AFR. Two—SAC's 43rd Bomb Wing—the Air Force's last operational group of Convair B-58 Hustlers—has completed its first six months of operational duty here.

Duties were then 4000 hours of engine flight time, reliability of the Hustlers' J79-AS turbojet engines was evidenced by a rate of approximately 400 hours between unscheduled engine removals for all causes.

Engine flight time for all phases of the Air Force's and Convair B-58 program is currently over 15,000 hours. Four General Electric J79s power the Mach 3 bomber with a combined thrust of over 61,000 pounds.

First Year of Flight Testing Confirms Aft-fan Principle

CINCINNATI, Ohio—General Electric's first year of turbojet flight testing has proven beyond a doubt the soundness and practicality of the aft-fan principle," according to G-E Commercial Engine Operations Manager Neil Harpaz.

His comment was occasioned on the first anniversary of American turbojet flight last February 19. On that day a year ago a G-E-based RB-56E low-altitude bomber by two CJ-465-33s.

"The engines," reported Mr. Harpaz, "have been operated over a complete range of altitudes and air speeds under severe distorted inlet conditions, and with two entirely new nacelle designs. The fact has in no way compromised the good throttle response characteristics of the engine."

"In all cases," he told, "we have been completely satisfied with the engine



G-E's modified 10-to-1 ratio J85 will be ideal for VTOL, STO, and other boost power

J85 Modified to Produce 10 to 1 Power Ratio

LYNN, Mass.—General Electric's J85 turbojet engine can now be modified to produce a thrust-to-weight ratio of more than 10 to 1.

Producers J85 engines currently entering service with the Air Force deliver a specified 7.6 to 1 ratio, the highest of any military production jet powerplant.

The 10 to 1 power ratio makes the modified J85 an ideal engine to provide auxiliary power for VTOL and STO, aircraft. There is no primary use would be to provide boost power for climb and landing operations.

Adaptation of the modified engine to helicopters, where it could substantially suggest thrust power and lift power, is also a possibility.

Boosting the J85's power ratio to 10 to 1 was accomplished by retaining compressor—reducing engine weight from 335 pounds to less than 300 and by increasing engine speed and temperature. Overall dimensions are similar to those of the J85-7.

A dry commercial version of the J85—the CJ-10—develops 38.50 pounds of thrust, weighs only 345 pounds.

On the engine (model GE2-6059) of new would like further information on the G-E J85 turbojet engine.

The CJ-805 Aloft: 880 Nears First Anniversary; 990 and

CONVAIR 680—First jetliner now in commercial service, the Convair 680 will enter its second year of operation on May 15. The CJ-805-3 powered transport is now flying Delta, Northwest, and Trans World Airlines, and will go to International Flight in mid-year when Japan Air Lines inaugurates 682 jet service linking Tokyo with other major Far East cities.

CONVAIR 990—The 645-mph jet flew for the first time on January 24 and is being flight tested prior to scheduled service with AAL, MEAL, Swissair, and SAA later this year. Four G-E CJ-408-21 turbojet engines power the 990, whose maiden voyage was described by Convair Chief Test Pilot Don Germann as "The cleanest B-7 in our test flights."



Caravelle Flight Tests Progress Well

SUB-DUGLAS CARAVELLE VII—Now entering its fourth month of intensive flight testing after conversion to General Electric CJ-465-33 turbojet engines, D.E.'s Caravelle VII is currently in the midst of a heavily instrumented flight program marked for completion this spring. Tests have included no-light engine demonstrations, deck inlet design confirmations, and thrust vector thrust performance tests, including nose level and short-circuiting, has been highly favorable.



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output down to the fixed-wing aircraft's elevator from this. The single unit squared outputs of an encoder and down and leveler assemblies and derives its input from the output of the pitch servo amplifier at the pitch power unit. Unlike the other power units, it does not contain its own separate servo amplifiers. It weighs 2.5 lb.

• **Highly controllable**—Located in the cockpit, the controller permits the pilot to enter his commands into the autopilot. All commands are entered by turning a knob, pitch commands by advancing or retarding the knob. For pitch commands the gyro actuators will change at a 2 deg/sec rate. When the knob is released after pilot command it snaps back to its center position and gyro actuators will hold the last position.

The controller also contains zero-effort indicators for comparing actual surface movements with a fixed reference and a roll trim control.

• **Cockpit-mounted navigational computer**—One for each version—Cockpit-mounted accuracy, accuracy and calculating elements in general control and lateral navigation aids to be coupled to the autopilot. The computer provides switches for pilot selection of constant magnetic index direction or a pitch slope of the ILS (all in vertical mode). In lateral mode, magnetic switches permit selection of automatic lateral control in magnetic compass heading, degree heading, ILS localizer bearing and VOR system.

• **Attitude reference control**—This unit, which consists of three synchros wired back-to-back with corresponding gyros, is a scaling of the heading of the aircraft and can be made. In response to a need of how the airplane should react. The autopilot corrects the attitude commanded by the synchro. When the autopilot is disengaged, the reference control provides gyro actuator in three axes.

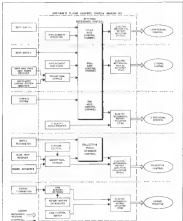
• **Virtual gyro**—Complicated self-contained gyro with multiple containing electronic circuitry provides signals proportional to pitch and roll changes.

• **Acceleration**—An accelerometer, a piezo-electric unit, provides signals proportional to side acceleration for two coordinates. Roll position is derived proportional to roll acceleration.

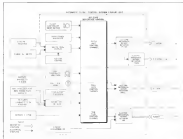
• **Reverberate altitude control**—Self-contained unit provides signals proportional to air density from selected barometric altitude.

Because of the more unstable characteristics of helicopters, the power units for rotor-wing systems are designed for different rates, rather than the more straightforward parallel, sequential display of the fixed-wing system, according to Kuhlman. Differential rotation enables pilot commands to override autopilot commands.

This change and the need for other

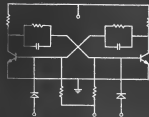


FLOW DIAGRAM for helicopter version of flight control system. Basically, the new modules employed in the fixed-wing system, supported by a collective pitch command control, give better accuracy and a few other components under the helicopter system.



FLOW DIAGRAM of Anair's universal flight control system (fixed-wing) shows functionally grouped components for their own flight control.

A NEW SYMBOL



Worth learning because it represents a front-running achievement in microminiaturization. The symbol represents a microminiature "flip-flop." It is a solid-state integrated circuit incorporating all the functions shown in the equivalent conventional circuit. Yet it occupies one transistor package. It makes a 90% saving in space.

The symbol is one of six. There are a series of these functional micrologic elements: flip-flop, gate, buffer, half adder, half-shift register and counter adapter. Entire computer logic systems can be built wholly from combinations of these six building blocks. They are directly interconnectable. Design time is minimal.

The schematic is symbolic of the device. The physical realization of such a highly practical micrologic concept is symbolic of its maker—Fairchild Semiconductor Corporation. The company's repeated success in the development of advanced semiconductor devices has been based on the fund knowledge, abilities and esprit de corps of our entire staff. We are proud of our newest development. We are prouder yet of the creative approach of our scientific staff that accomplished it.

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controls require several digits to 4 numbers and some additions to the basic modules of the system. Output elements of the pitch and roll power units, for example, are designed for flexible change to accommodate different rotation techniques. Two linear actuators (screw, rack) are added while the power units for the other three helicopters are the same as in the basic wing system. The latter three power units control pedals (yaw), collective stick, horizontal control and rotor speed.

The flight controller employed in the fixed wing aircraft does not appear in the helicopter system. This controller for heading and attitude which were entered in the flight controller is integrated into the helicopter control stick. Besides the attitude reference control in both systems, a collective pitch command control is added for helicopters. This position autopilot mechanism is collective pitch when the autopilot is not engaged and attitude reference when the autopilot is engaged. Sensor units for the helicopter system are identical with those of the fixed wing system and supplemented by a rotor system transducer which senses the position of the collective stick. It anticipates power demands on the engine and advances the throttle accordingly.

An open collector which contains an open wiring network serves close control of the helicopter's status. In tests with the Verid 1921, for example, it demonstrated steady state accuracy to 10 rpm (engine speed) and dynamic accuracy to 40 to 50 rpm (engine speed).

A signal flow diagram for the helicopter version of the flight control system appears in an accompanying drawing. Five control channels for three flight axes, collective pitch control, yaw (altitude) and engine rpm are shown. When engaged the system provides attitude and heading and engine rpm, stabilization, altitude control and/or automatic pitch guidance. As in the fixed-wing system, each channel is electrically independent of the other but roll and yaw are coordinated for limited turns.

Operation of one of the channels, collective pitch control, which is a new helicopter altitude, is as follows. The collective pitch power unit receives signals from three sources—roll after-actuator, barometric altitude control and glide path receiver. It then properly partitions the collected pitch control.

When the barometric altitude control function is selected signals are fed through the navigational computer to the collective pitch power unit to maintain the helicopter's altitude. Searchlight, glide path and rotor attitude signals are control approach as well as altitude if they are selected.



TI developed 35,000 transmitters and power supplies operated in "hot" telemetry operations and TI will supply 100,000 systems for later TELEMETRY work.

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... another Eastern cooling system uses a liquid-to-air exchanger to dissipate heat generated by electronic components. Without such a device, heat would build up around the high voltage power supply and transmitter faster than it could be dissipated by convection or fan cooling. The dual flow cooling pack weighs only 110 pounds and fits in a compact 26" x 20" x 24" volume. It is only one among a large family of such units manufactured by Eastern Industries. If you have an electronic cooling requirement from 50 to 50,000 watts dissipation rates, contact



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Cornell Uses Long-Duration Shock Tunnel

By David A. Anderson

Belted-Correl Aerodynamic Laboratory is installing a hypersonic shock tunnel with test duration measured in seconds instead of milliseconds.

The new blowdown tunnel will have

a test section long enough—about 33 in.—to handle long, nearly full-scale models of aerospace craft and will be capable of simulating the correct heat flux in hypersonic environments.

Test Mach number range will be between 6 and 15, with stagnation

temperatures as high as 0.003R, at an inflow rate of 4.5 lb/sec and test times up to 1.5 sec.

Cycling time for a run will be about four hours.

Reason for the long test time is the unique driving section of the tunnel. This is a wave superheater, a rotating assembly of 180 separate shock tubes, cycled once per revolution of the superheaters. During every single rotation of the assembly, each of the shock tubes is cycled once with charge driving, cooling, and purging gas supplied from nozzles around the periphery. A complete cycle takes about 27 milli-seconds.

Prototype of the wave superheater has been investigated and proven at a small-scale test. Built and tested by Cornell under sponsorship of the Office of Scientific Research and Development Contract Office of Scientific Research, the sponsored design study for the full-scale superheater about 23 months ago. The project was taken over by Advanced Research Projects Agency with technical monitoring by AKDC's Avond Pioneering Development Center.

Rotor of the wave superheater has been installed by Cornell Laboratory, and the tunnel now is shut-down and calibration runs will be in order for Mach 6 tests by Feb. Mach 15 capabilities is expected to be reached by Feb. 1962.

Shock Tube Cycle

Each of the shock tubes in the rotor of the wave superheater operates just like a driver shock tube. A mounting piston at high pressure gas (the driver) drives through the shock tube creating a shock wave in the low-pressure gas (the charge) stands in the tube. The shock wave compresses the charge gas, heats it and launches it out of the tube. The compressed gas then expands through a nozzle to create test conditions.

In a stationary shock tube that process is varied by the instant rupture of a diaphragm separating the driver and charge gases. In the rotating assembly of shock tubes the open end pass by a series of nozzles at each end of the driver. In the driver gas at the upstream end and is sent to or discharge the appropriate gases at the downstream end.

The rapid passage of the open end past the nozzle—at a velocity of about 200 ft/sec—creates like the quick-open-

Rotor Design

Operation of the wave superheater depends on the rotating assembly of 230 shock tubes that furnish the drive of high temperature air by the collision inside. This rotor, which operates in a temperature environment of 5000°K, weighs about six tons, and rotates at speeds up to 2700 rpm. To give a lower velocity of the shock tube center line of about 780 ft/sec. Tube centers are on a 2.5 ft radius from the rotor.

The rotor was designed like a gate loop, with an entrance on sports under stress. It is fabricated at three stages of longitudinal W steel, cored with Inconel in the largest shaft and support frames made at that material by U. S. Steel.

Final machining was the responsibility of the Inertial Control Machine Co., Utica, N.Y. The approach was to drill holes simultaneously from both sides of each ring and then bolt the three rings together on the inside.

It took more than a year to do the drilling and boring job, as well as the other machining on the rotor. Drills, benders and cooling systems for the job were specially designed and built. For the company, it was a "unique" task operation.

ing valve action of the inboard diaphragm.

A complete cycle for one tube works this way:

The tube picks up a charge of preheated air from a downstream nozzle. It isolates past the upstream driver gas nozzle and a plug of high pressure, helium blasts into the open end of the tube. The forced shock wave moves down the tube, followed by a plug of superheated air. The tube then rotates just a downstream collector nozzle and discharges superheated air into that nozzle.

At the next rotation station, the driver gas blows down into a collector tank nozzle, and continues to do so as it rotates until the driver gas pressure is down to about two atmospheres. At this point the downstream end of the tube is opened to the rotor around the rotor.

In the time the driver pressure in the tube has decreased to about one atmosphere, the tube has rotated to a casual gas nozzle downstream. The nozzle bursts in helium and releases the flow through the tube at that station of the gas is now in an optimum condition.

Immediately after entry of the end, the tube passes at least of the fifth downstream nozzle which purges the tube with helium at rotor temper-



BANDER II—National Aeronautics and Space Agency space vehicle for a United States lunar probe—was digital command decoder developed and built by TI for the California Institute of Technology and Jet Propulsion Laboratory.

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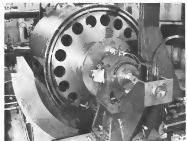
When I was as old as my father is now, I shall be five times as old as my son is now. By then my son will be eight years older than I am now. The combined ages of my father and myself are 100 years. How old is my son?

—The Week End Book

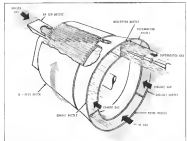
962 is the number of different transformations made by our "Bird Divisor." These include transverse, longitudinal, torsional, and other transformations (transformers) in name but a few. Would be to several models in our Bird line of interest to you transformer people. Ask for Catalog TR-61—a home packed with information—U. S. Bird Transformer Corporation, 4033 Redwood Avenue, Venice, California Phone UPhon 0-3380.

ANSWER TO LAST WEEK'S PROBLEM: Dividing by X', Y', Z', respectively the ages of A, B, C, we have the equations: $X' = Y' + 2$; $Y' = Z' + X' + 14$; $Z' = X' + Y'$. From these it is possible to obtain an equation of the 10th degree, but the only integer values of X, Y, Z can, with not too much difficulty, be obtained from the original equations: $X = 3$, $Y = 5$; $Z = 2$ and A is 27 years old, B is 25, C is 9.

UTON INDUSTRIES
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ROTOR of wave superheater shows before driving, around 230 individual, small shock tubes give continuous supply of superheated air for hypersonic wind tunnel.



SCHEMATIC DIAGRAM of wave superheater operation shows location of gas tubes during cycling. Complete cycle at individual shock tube takes about 27 milliseconds.

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Standard hermetically sealed indicator, available in 1½" and 2", Model 236, a 2" indicator, is integrally lighted in daylight, neon/valve and pointer are white and oil sight red. When power is off, pointer will move off-scale below zero.



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FINANCIAL

Stock Transactions

The Securities and Exchange Commission's Bureau of Securities Transactions and Registration Holdings for the period Dec. 31, 1960 to Jan. 10, 1961 reported the following transactions in the shareholders of General Motors Transportation Corp. acquisition of 9,160 common shares by the Vitro Co., Inc., Inc. of New York, Inc. holding a holding of 201,480 (SW Feb. 25, p. 26), acquisition of 300,5475 preferred shares, held indirectly in John C. Maxwell, Inc., Inc. and disposition of 300,5475 preferred shares, held indirectly in John C. Maxwell, Inc., Inc.

Other transactions for the period Dec. 11, 1960 to Jan. 10, 1961, are:

General Electric Corp. Disposition of 10 common shares by John C. Maxwell, Inc., Inc. holding a holding of 401.

General Electric Corp. Acquisition of 1,000 common shares held indirectly by Henry J. O'Connell, Inc., Inc. holding a holding of 1,000 (SW Feb. 25, p. 26), acquisition of 100 common shares by Henry J. O'Connell, Inc., Inc. holding a holding of 100.

General Electric Corp. Acquisition of 100 common shares by John C. Maxwell, Inc., Inc. holding a holding of 100 (SW Feb. 25, p. 26), acquisition of 100 common shares by John C. Maxwell, Inc., Inc. holding a holding of 100 (SW Feb. 25, p. 26).

General Electric Corp. Acquisition of 1,000 common shares by Henry J. O'Connell, Inc., Inc. holding a holding of 1,000 (SW Feb. 25, p. 26), acquisition of 100 common shares by Henry J. O'Connell, Inc., Inc. holding a holding of 100 (SW Feb. 25, p. 26).

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U.S. Army UH-1H helicopter with AR 100 engine. All weather high compression compression engine developed and built by TI in cooperation with the U.S. Army Signal Corps.

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NEEDED: more Electronics Engineers qualified to work on advanced missile detection systems

Complexity of, for example, the BMEWS project, indicates the need for experience, competence... highlights the kind of opportunities open with General Electric's Missile Detection Systems Section.



Within the next ten years the need for qualified engineers and scientists will quadruple in the field of missile, space-probe and satellite detection. This prediction is made by General Electric's Missile Detection Systems Section, based on present and anticipated space vehicle state-of-the-art.

And because of this, there is a possibility that a technical manpower "vacuum" may develop in what many consider to be one of the most vital, fast-growing technologies of the space age. What's needed are more engineers who can meet the strict requirements. For example:

It takes a unique kind of engineer to work in the field of detection. An Advanced Systems Engineer must be extremely competent technically. Yet, he must also be something of a "dreamer"—able to anticipate and define future problems as well as conceive practical systems solutions. To do this, he must keep abreast of virtually every significant advancement, not only in his own, but in other fields.

The same holds true for Equipment Specialists who must meet exacting detection-system specifications. Yet, there are relatively few pointed fields where this kind of specialized experience can be obtained.

BMEWS is a good example of the magnitude of system and equipment requirements. Its 16,000 square-foot antenna reflectors had to be engineered to hold a $\frac{1}{4}$ of an inch tolerance over a 120° tem-

perature range... with a 2-inch tolerance in winds up to 185 mph. Its radar detection sub-system, designed and developed by G.E.'s Missile Detection Systems Section, searches multi-million watt pulses... to receive milliwatt-microwave echoes. And this is just one part of a complex system to detect missiles, calculate trajectory, impact area, impact time, and point of launch.

It's indicative of why the Missile Detection Systems Section can offer growth opportunities in a technology that has some of today's most unique engineering and scientific challenges.

IMMEDIATE OPENINGS FOR SYSTEMS EXPERIENCED ENGINEERS AND SCIENTISTS

General Electric's Missile Detection Systems Section has openings right now for qualified scientists and engineers anxious to broaden their experience and continue their professional careers in this exciting new technology. Although requirements are necessarily high, the opportunities for rewards and advancement are unusual.

DEFINING FUTURE SPACE PROBLEMS...

... is the job of the Advanced Radar Systems Development Engineer. There is no immediate need for competent men to conceive detection systems that will outpace the most advanced state-of-the-art in missiles, space-probes and satellites.

Advancement is in keeping with the highly demanding nature of this position. Your responsibilities will include determining broad parameters for—and establishing feasibility of—advanced detection systems. Basic requirements include a BSSEE, an advanced degree, and five to ten years' experience in systems design and analysis.

PROVIDING HARDWARE SOLUTIONS...

... for future detection systems is the job of the Systems Analysis Engineer. A high degree of technical competence and the ability to manage are prerequisites. In this position you will specialize in evaluating missile defense systems and coordinating the tools and talents of the organization in order to

obtain optimum configurations based on utility, performance, cost and delivery.

Basic requirements include a BSSEE degree, Physics, or Math. You should be familiar with mathematical probability, systems simulation, operational analysis, and generalized harmonic analysis.

PROGRAMMING COMPLEX DATA...

... is the challenging job of the Senior Programmer in Computer Operations. This job requires an ability to interpret problems related to analysis of missile detection systems. As group leader, you will be responsible for computer programming and other detailed investigations.

Basic requirements include a BSSEE or Math degree, with three to five years of experience on large scale scientific computers.

INSTALLATION, CHECKOUT AND INTEGRATION...

... must be successfully accomplished by the Systems Engineer working at the installation site. As such, you will be responsible for actual system installation, checkout, and integration with all other systems or subsystems. Your job will include initial operation of the system and training of operating personnel. Rewards are in keeping with the highly demanding nature of this position.

Basic requirements include a BSSEE degree with five years' experience in radar, high power transmitters and/or automotive systems.



FOR MORE INFORMATION:

or for a copy of this new brochure which describes the challenging and rewarding opportunities open to you in General Electric's Missile Detection Systems Section, write today to: Mr. Dean S. Brown, Missile Detection Systems Section 5-13, General Electric Company, Court Street, Syracuse, NY.

GENERAL ELECTRIC

FUTURE DEFENSE, SPACE PROBLEMS

Future-generation space vehicles will necessitate even more sophisticated detection systems. The creation of such systems is the job of the Advanced Radar Systems Development Engineer. Qualifications are high... but the rewards are in keeping—the opportunities for advancement excellent.

PROVIDING IS-MINUTE WARNING

BMEWS' massive radar reflectors are indicative of the system's complexity. According to MITRE, few electronics engineers will be needed within the next decade for every one now working on such systems.



OFFICIAL AIR TRANSPORT FACTS AND FIGURES ISSUE

MAY 1

Official Operating Statistics of The Air Transport Association

For the past five years, AVIATION WEEK and Space Technology has published "Air Transport Facts and Figures," the official operating statistics of the Air Transport Association.

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Ling-Temco Profit Rose in 1965; Company Is Optimistic About 1966

Dallas, Tex.-based electronic outfit Ling-Temco (LTC) is seen by Ling-Temco Electronics' business downbeat, and owned by Board Chairman Robert McCulloch and President James J. Ling.

They reported that net earnings for the firm after taxes in 1965 totaled \$1,251,172, up slightly from the previous year's \$1,029,558. Last year's sales totaled \$148,447,484, down only slightly from 1964's \$146,725,916.

Despite the loss of some \$16 million in planned sales as a result of Navy cancellation of the company's major missile projects, Corvus, the Jolt and the return of the contract for a research and development level (AW May 25 p. 35).

The share earnings of the company in 1965 were \$1.25, including 11 cents of non-recurring income, compared with \$1.22 the previous year which included 18 cents of non-recurring income. McCulloch and Ling told stockholders that the company is continuing a policy of re-inventing earnings, thus paying dividend payments.

Good earnings were experienced in the third and fourth quarters, despite general business contractions due to the economy. For 1966, Ling-Temco also showed the breakdown, posting up results of its expansion as electronics and aerospace contract electronics, communications, and defense and space system accounted for \$117 million or about 79% of its activities, defense components, 325 million, or about 17% and all other enterprises, 95 million, or about 6%. Ling-Temco's research and development expenses last year totaled \$2 million over the previous year for a gain of 31%.

Ling-Temco backing, including letters of intent and contracts, is again growing, totals more than \$100 million, the company reported.

Shareholders' total equity amounted by \$4,277,544 last year to a total of \$26,112,916, largely because of return of dividends. Total assets increased \$26,426,190 to \$83,429,613, with working capital at \$12,555,481 as of Dec. 31, 1965.

The company had, effective Dec. 1, a new line of credit of \$27.5 million, expiring prior line agreements. It reports that it plans no additional equity financing.

The financial statement makes note of the fact that Ling-Temco has acquired 21.5% of Chance Vought Corp.'s outstanding stock—additional holdings by Ling-Temco President James J. Ling and ministers actually bring this holding to about 35% and that is currently

the subject of a suit filed by Chance Vought in federal court alleging violation of antitrust laws. Ling-Temco filed counter-suits, promising a recent Chance Vought injunction and also for the purpose of obtaining a list of Chance Vought stockholders. Chance Vought directors have issued their stockholders stating, back from Apr. 15 to May 25, Ling-Temco's stockholders will meet Apr. 10 (AW May 6 p. 36).

The company states that its research and development expenditures last year were some \$2,846,345 plus approximately \$6 million expended by its defense and military customers on new projects.

Highlighting research projects under way in the company were:

- Development of electronic information display system to include missile defense plotting system and the Navy's new defense system.
- Underwater operating high-power acoustical transducer, for use in mining and long range anti-submarine defense.
- Electro-optic space reconnaissance system being studied under a classified contract.
- Electronic research laboratory in studying molecular electronics, among other items.

Use of the electro-optic electron picture of a solid state tube and increasing the transparency of solid state tubes was under study by the company, as well as a variable springback gas meter and a high power electron beam for laser fusion.

Ling-Temco executives also reported to stockholders their areas of interest in which the company expects to expand its efforts in 1966.

Equal emphasis will be placed on the commercial-consumer market for electronics as well as on military applications, considering that electronic electronics markets, volume this year at some \$16.1 billion—up 15% increase over 1965—is more than enough to absorb these markets. The firm says that it will accelerate efforts for applications of electronics in the commercial-consumer field—beyond the original military functions—for many products.

Ling-Temco plans to step up its efforts in such fields as radio astronomy, which it views as a major future market. It reports that, moreover, it has that there is still no law for quantum radiation similar to the one it constructed in Cutler, Me., for the Palomar station. It has proposed a VLF system for a hardened installation in a

south of an extension from USAF, and the British government has received a proposal for a NATO VLF installation in England.

The company focuses, instead of interest in requirements for some systems in aerospace vehicles as well as submarines, nuclear vessels and other vessels and envisages some subsystems following the history of radio subsystems.

New Offerings

American Machine & Foundry Co., New York, N. Y., the company and its subsidiaries, manufacture, sell and lease a diversified range of products for aerospace and industrial use, and also perform a substantial amount of contract engineering and manufacturing relating primarily to the defense program of the U. S. (include ground support). Offering a \$40.5 million of convertible subordinated debentures, due May 1, 1981, for subscription by company stockholders on the basis of \$100 principal amount of debentures for each 10 shares of common stock, the offering date, subscription price and underwriting terms to be completed by agreement. Proceeds will provide additional working capital to finance the company's expanding business and will be applied to the payment of all outstanding short-term loans, which at Dec. 31, 1965, aggregated \$10 million. Such loans were made to meet the cash requirements of the company's increased investment in inventories, accounts receivable and operating operations.

Copter Skyness, Inc., Pittsburgh, Pa., organized in August, 1965, for the purpose of developing the commercial use of helicopters in the Pittsburgh area. In September, 1965, it acquired all the stock of Pittsburgh Airways, Inc., and to hold a certificate for transportation of persons and property by helicopter between Pittsburgh through Dallas, Jacksonville and Sacramento, Nevada. Its offering is \$15,000,000 shares of no par common stock, for public sale at 4 cents per share. Company proposes to apply the proceeds to the acquisition of all the basic operating property and capital deemed necessary to commence business, including \$150,000 for a helicopter and \$65,000 for a lease of operations.

Rockwell Research Corp., Seattle, Wash., organized under Washington law in 1959, and to date primarily engaged in research on new high energy propulsion systems, the development of a reusable rocket for application to satellite and space vehicles and a rocket-powered pump and in the preparation of property which have been submitted



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To contact Aerospace Corporation, Office of Personnel Services, 19100 Vanowen St., Vanowen Station, Vanowen, N.Y. 11781, call (516) 337-1000. For public sale of \$1.55 per share. Of the proceeds, \$150,000 will be used for research development programs; \$115,000 for acquisition of new offices, libraries, manufacturing facilities, scientific and technical equipment, ship and shipyard modernization, office furniture and for a remote, select test facility (including equipment). \$20,000 for representation of the firm from the proposed underwriter, \$115,000 for working capital for research sponsored by government agencies and for manufacturing equipment. The balance for future research development and manufacturing activities and required plant and facilities expansion.

Cotton Components, Inc., Caldwell Township, N.J., engaged in the development, design, manufacture and sale of superhigh-speed gun or piston (rifle) for sale and television and a diversified line of permeable detectors for microwave systems. Offering a 107,000 share of common stock, the public sale at \$3 per share, at least 100,000 shares were to be sold within 60 days after the date of the offering or more of such shares will be issued or sold. Of the proceeds, \$100,000 will be used for the commercial manufacture of firearms including the purchase of equipment and the creation of an inventory. \$100,000 to expand the business of Microwave Components, Inc. and Pennsylvania Testing Laboratories, Inc., which are to be acquired by the company by an exchange of stock in the event this offering is successful, and the creation of a new testing facility to be built at the company's plant in New Jersey. \$10,000 to be used to acquire working capital, and the balance will be added to general working funds.

DeWitts, Inc., Orlando, Fla., engaged in the design, manufacture and sale of electronic equipment and systems, including radars, digital and analog systems. Offering a 120,000 share of common stock for public sale, offering price and underwriting terms to be supplied by underwriter, an additional 30,000 common shares are to be offered at \$1.75 per share to holders of outstanding bearer warrants. Of the proceeds, \$100,000 will be used to reduce current bank borrowings; \$50,000 for the purchase of new test equipment and the erection and equipping of additional manufacturing facilities on its leased premises; the balance to provide working capital.

Dynasty Instrument Corp., Westbury, N.Y., engaged in the design, manufacture and sale of electronic equipment and systems, including radars, digital and analog systems. Offering a 120,000 share of common stock for public sale, offering price and underwriting terms to be supplied by underwriter, an additional 30,000 common shares are to be offered at \$1.75 per share to holders of outstanding bearer warrants. Of the proceeds, \$100,000 will be used to reduce current bank borrowings; \$50,000 for the purchase of new test equipment and the erection and equipping of additional manufacturing facilities on its leased premises; the balance to provide working capital.

General Precision Equipment Corp., Englewood, N.J., engaged in the design, manufacture and sale of electronic equipment and systems, including radars, digital and analog systems. Offering a 120,000 share of common stock for public sale, offering price and underwriting terms to be supplied by underwriter, an additional 30,000 common shares are to be offered at \$1.75 per share to holders of outstanding bearer warrants. Of the proceeds, \$100,000 will be used to reduce current bank borrowings; \$50,000 for the purchase of new test equipment and the erection and equipping of additional manufacturing facilities on its leased premises; the balance to provide working capital.

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Financial Briefs

Vitre Corp. 1960 consolidated net income was \$773,141, a rise of 25% over 1959's figure of \$595,712. Revenue for 1960 totaled \$18,118,193 compared with \$16,301,229 for 1959.

General Controls Co. net earnings in 1960 amounted to \$2,091,111, a 10% drop from \$2,312,973 earned in 1959. Net sales, however, totaled a record \$40,135,385 compared with \$40,013,611 registered in 1959.

Bako Aircraft Corp. net earnings for the six months ended Jan. 31, 1960 rose \$2,223,729 on sales of \$79,285,424. The same period a year ago showed a net of \$1,737,811 on sales of \$69,313,660.

McDonnell Aircraft had earnings of \$5,929,301 on sales of \$167,968,644 for the six months ended Dec. 31, 1959. Net earnings for the first half of fiscal 1960 were \$5,916,000 on sales of \$173,313,144.

DeWitt-Parkland Co. reported record sales of \$68,206,915 in 1960. Earnings were also at a high of \$4,228,445. These figures compare with 1959 sales of \$47,745,073 and earnings of \$3,889,941.

General Precision Equipment Corp. reports its preliminary figures that sales for 1960 rose \$214,000,000, up 13% from the 1959 figure of \$215,588,400. Earnings for the year ended Dec. 31, 1960, rose to \$1,300,000 in \$1 per share of common stock, compared with 1959 earnings of \$4,198,200 at \$2.61 per share.

Burroughs Corp. sales reached a new high in Fiscal 1960 at \$399,208,550, compared with \$399,778,068 in 1959. Net earnings for 1960 after taxes were \$9,235,867 or \$1.59 per share. The 1959 earnings were \$7,100,367.

Chicago Aerial Industries had a loss of \$717,500 for the six months ended Dec. 31, compared with a profit of \$109,574. Sales fell from the 1959 record of \$12,388,000 to \$6,790,000 this year.

The **Sauger Corp.** sales rose \$48,013,965 and earnings were \$1,776,889 for the six months ended Dec. 31. Total share earnings in the first half of the company's fiscal year were \$30, based on 2,216,947 shares outstanding. Company figures include sales and earnings for the six-month period of Jack & Hebert which was merged into the Sauger Corp. Feb. 2, 1961.

Republic Aviation Corp. sales for 1960 rose to \$287,679,000 compared with sales of \$285,063,870 in 1959. Earnings in 1960 were \$4,652,000 or approximately \$1.25 a common share on 3,741,448 shares outstanding. This is up from a net loss of \$189,000 or \$5.15,107 at \$2.17 a common share in 1,437,148 shares outstanding.

Westinghouse Electric Corp. had a net income in 1960 of \$77,977,000 or \$2.21 a common share on sales of \$1,910,740,000. Sales in 1959 were \$1,910,740,000 and income was \$85,947,000 or \$2.41 a share. In 1958, income of \$7,196,800, equal to 23 cents a share rose in the form of special net return income from a federal tax refund.

Mace Shinnell and Associates, Inc., a consulting firm specializing in the electronic computer field, showed a profit after taxes of \$2,600,000 as a gain income of \$178,135 for the six months ended Dec. 31, 1960. Gross income for the six months ended Dec. 31, 1959 was \$1,300,491 with profit after taxes of \$28,880.

Hercules Powder Co. reported 1960 net sales and operating income of \$730,903,000 compared with \$681,680,000 for 1959. Net income of \$27,145,000 for 1960 was equal to \$3.85 a share of common stock after dividends and dividends on preferred and Class A stock.

Packard-Bell Electronics Corp. had a \$165,000 loss for the first three months ended Dec. 31. Deficit for the first three months amounted to \$82,758,190 compared with \$12,330,018 for the same period last year. Multitronics (now backing) however, matured in all time high of \$17,700,000 compared with \$6,500,000 at the end of the first quarter a year ago.

International Rectifier Corp. reported sales of \$6,941,832 for the second half of 1960, a gain of 6.1% over \$6,595,201 for the same period in 1959.



15 SECONDS ON THE SURFACE OF THE SUN

Cornell Aeronautical Laboratory has devised a new facility, the "Wine Superheater", which simulates, for approximately full scale models, the extreme conditions of hypersonic flight. Temperatures of roughly 5000° F., suitable for research on early hypersonic problems, can be generated in the wine—put it all out, approximately 15,000° F. after that, it's a burn. Two tests of 15 seconds at speeds up to Mach 15 can be obtained in this continuously operating shock tube device. The large, 40 square foot test section permits simultaneous testing over a much greater range of test conditions than can be accommodated in any existing facility. Such comparative testing gives the engineer a means of checking aerophysical and aerothermal predictions.

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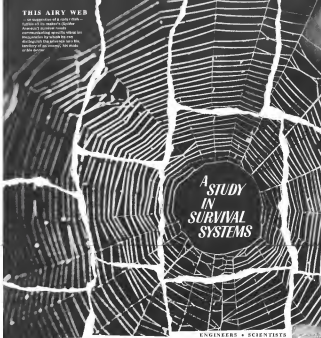
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ALPHATRAVE WEEK, April 3, 1962



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